

American Optical Co.

# SPENCER

## Scientific Instruments



American Optical Company  
*Scientific Instrument Division*  
Buffalo 15, N. Y.



*Charles A. Spencer, 1817-1887, first American Microscope builder.*

## American Optical Pioneering

American Optical Company is an institution founded 113 years ago with executive offices and factories in Southbridge, Massachusetts, and manufacturing divisions in Buffalo, N. Y., Brattleboro, Vt., Putnam, Conn., and, in Canada, in Nicolet, Que., and Belleville, Ont. The Company maintains branch laboratories in 281 principal cities. More than 12,000 men and women constitute the AO family.

American Optical Company manufactures and distributes technical products used by the professions in providing visual efficiency, aviation and industrial goggles, body protection for industrial workers, and sun glasses.

In 1935, the Spencer Lens Company at

Buffalo, N. Y., became the AO Scientific Instrument Division. It manufactures ophthalmic instruments as well as the optical instruments used in medical practice, education, television, research, and industrial control.

During World War II, naval and military fire-control instruments, sighting devices, prism binoculars, and optical parts were produced.

The instruments in this catalog carry the famous name of Spencer, which is today, as it was in the past century, a guarantee of the finest quality available in scientific instruments.

The first American microscope, a medical type, was built in 1846 by Charles A.





*American Optical Company, Southbridge, Massachusetts.*

Spencer of Canastota, New York, for Dr. C. R. Gilman of the College of Physicians and Surgeons.

After its completion, the microscope was tested by Professor J. W. Bailey of West Point, at that time one of the leading microscopists in America. Bailey was astonished to find that he could reveal details which were beyond the resolution of his expensive European microscope.

Spencer won world recognition when he produced an objective which was the first to resolve the lines on the sigmoid Navicula, one of the most difficult of test objects. This diatom was later named *Navicula spencerii* in his honor. In June, 1851, he succeeded in producing what was then considered an impossibility by European microscopists—a  $1/12''$  objective with an aperture of  $178^\circ$ . Years later, at the International Exposition in Paris in 1878, son Herbert Spencer's objectives, based on his father's formulas, competed with Europe's finest and were awarded the only gold medal presented for excellence in micro-

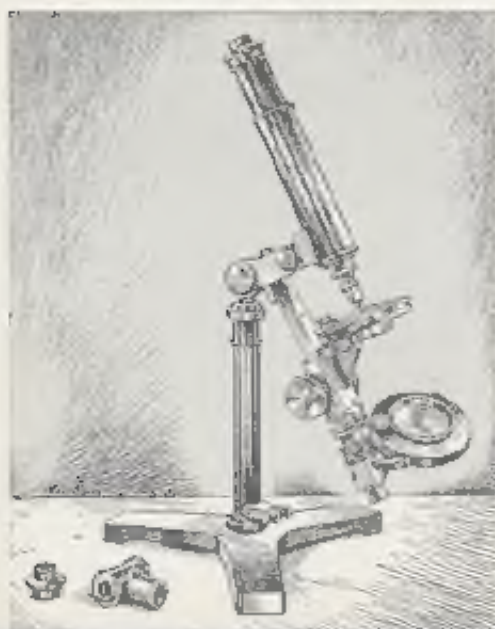
scope objectives.

That kind of craftsmanship illustrates the perfectionist standards of the Spencers, father and son. Every instrument, with them, was a challenge to something better. These same ideals of workmanship have always been a part of the tradition of American Optical Company. Their personal care in constructing an instrument by hand is matched, in this twentieth century, by advanced engineering and highly precise machine methods.

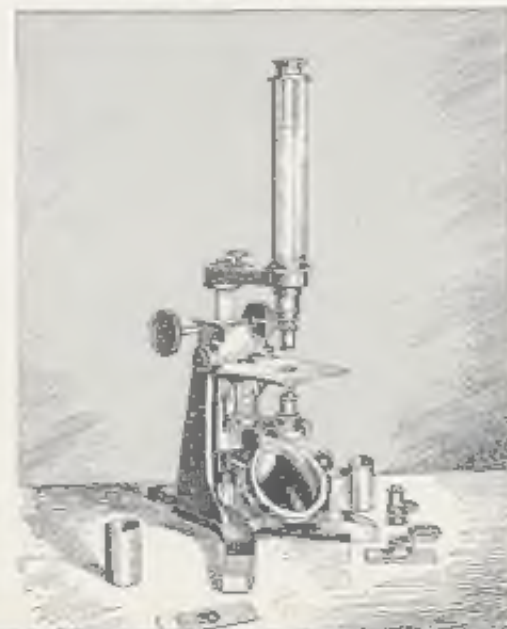
Now, much of the routine work performed by hand by early microscope builders can be handled by machines with almost incredible efficiency and speed, while improvements in design and ingenious inspection methods now in use at American Optical Company assure a constantly advancing standard of quality.

Certainly the Spencer name on a precision instrument will continue to be recognized as the hallmark of quality, and Spencer instruments will continue to satisfy the world's most critical investigators.

*Spencer Microscope about 1861.*



*Tinsman Microscope about 1934.*





## Complete Modern Facilities for Scientific Instrument Production

Early microscopes were often the work of a single craftsman who ground and polished his own lenses, turned the brass lens mounts and machined the stands. He manufactured and assembled complete instruments. The progress of science, however, increased the demand for optical instruments. Consequently improved production, through specialization, replaced the slow, tedious methods of old.

As a result, our plant has been able to produce more and better microscopes while continually pioneering and experimenting. Facilities which years of experience have shown to be valuable to optical production are found in the modern Buffalo factory. Spacious, well-lighted rooms; special dust free, air-conditioned departments; newly developed machinery—all assure the highest attainable standard of quality.

Research ranks first in the production of scientific instruments. The Research Department, composed of experts in the fields of science, creates new instruments and products, plans improvements, and computes optical systems. Under their supervision is an optical laboratory for producing and testing experimental optical systems.

In the Engineering Department, specialists in instrument design lay out mechanical details of instruments and the tools for their manufacture. The Mechanical Development Department, a complete machine shop, is devoted to production of pilot models of new instruments.

### For Producing Fine Optics

The quality of workmanship found in the departments which fashion optical

systems, sets the optical industry apart from all others. Here fine optical glass of the many types necessary to correct aberrations, is first molded under intense heat, or sawed to the approximate size. These "blanks" then go through various grinding operations, either by machine or by hand, until they are of proper size, curvature, and surface quality for polishing.

The utmost patience and skill are needed to polish glass elements to the high degree of perfection demanded in a Spencer instrument. During the polishing operations surfaces must be examined for flaws under a magnifier. Finally, they are tested with a master glass for determining precision of surface by Newton's rings. When these rings spread out, forming an even straw color, they represent accuracy to a millionth of an inch—the most critical measurement known to science.

After careful cleaning and rigid inspection, lenses must be centered accurately and mounted permanently into their cells—a mechanical operation which brings physical and optical centers into coincidence.

A complete Mechanical Section produces the stands, stages, lens mounts and innumerable other parts which complement the optics. Row upon row of automatic screw machines, turret lathes, drill presses and every type of boring, milling, grinding and specialized machine necessary to form metal parts is found in this department. Grinding and polishing machines prepare the surfaces of parts for enameling or plating. Then they are sprayed with enamel in cavernous sheet metal booths and transferred to ovens for baking to wear-resist-

*American Optical Company, Scientific Instrument Division  
Plant at Buffalo, New York*





ing hardness. Some parts receive as many as six coats of enamel, each carefully baked and hand rubbed to satin-like smoothness. In the plating departments, most bright parts are given protective coatings of the metal most suitable for the function to be performed.

### For Assembly and Inspection

A survival of old-time craftsmanship is found in the Assembly Department, where there is none of the rush or noise of ordinary assembly line production. Men with complete sets of tools put entire assemblies together and then test their own work. A few of the many operations accomplished in this department requiring exceptional skill and concentration include aligning the complicated system of the prism in an inclined binocular microscope, adjusting the inclination joint to the exact resistance necessary to hold the microscope in stable equilibrium, accurately fitting the fine adjustment mechanism for smoothest operation.

Further inspection for optical quality, perfection of mechanical parts, and satisfactory performance of the complete instrument under actual working conditions is carried out by experts who are as critical of performance as the scientist who will ultimately use it.

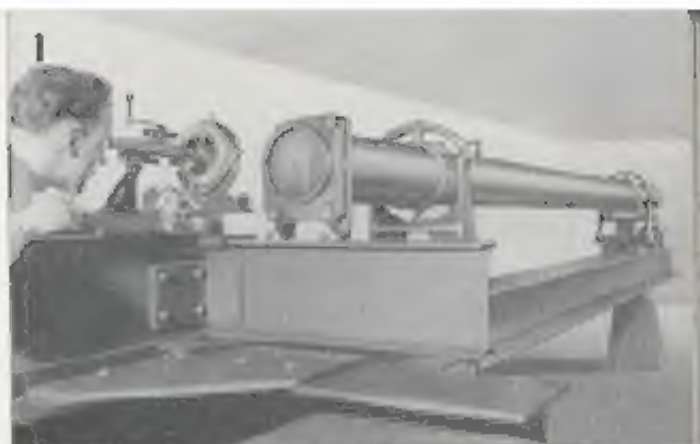
1. The accuracy of a test lens is checked by the Retard Defectometer.

2. Small binocular lenses are ground to shape by hand.

3. Lens curvatures must be accurate to a millionth of an inch.

4. Mechanical parts are made by most modern methods.

5. Final assembly requires experience and ingenuity.



5





## Representatives

Company representatives are stationed throughout the United States. They are available to answer your questions about Spencer scientific instruments. Their optical

experience and factory training should be helpful to you. Telephone or write to the nearest office listed below or to the factory at Buffalo 15, N. Y.

### *Offices of the* AMERICAN OPTICAL COMPANY SCIENTIFIC INSTRUMENT DIVISION

#### Atlanta

5 Plaza Way, S. W.  
Box 4208  
Atlanta 2, Ga.

#### Boston

110 Tremont St.  
Boston 8, Mass.

#### Buffalo

Box A  
Buffalo 15, N. Y.

#### Chicago

10 S. Wabash Ave.  
Silversmith Bldg.  
Box 804  
Chicago 90, Ill.

#### Columbus

40 South Third St.  
Room 216  
Columbus 15, Ohio

#### Dallas

1709-11 Commerce St.  
Box 1929  
Dallas 1, Texas

#### Los Angeles

314 West Sixth Street  
Box 2275 Terminal Annex  
Los Angeles 14, Calif.

#### New York

70 West 40th St.  
New York 18, N. Y.

#### Philadelphia

1522 Chestnut St.  
Philadelphia 3, Pa.

#### Pittsburgh

526 Penn Avenue  
Box 1108  
Pittsburgh 30, Pa.

#### St. Louis

407 North Eighth St.  
Box 1439  
St. Louis 1, Mo.

#### San Francisco

Rosenstock Bldg.  
28 Geary St.  
San Francisco 8, Calif.

#### Washington

1317 New York Ave., N. W.  
Washington 5, D. C.

## Foreign Representatives

For information concerning foreign representatives who supply the scientific instruments described and listed here, please

communicate with the Export Sales Department of American Optical Company, Southbridge, Massachusetts.



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## Terms and General Information

### Placing Order

When ordering, please indicate catalog number and name of equipment. If there should be any doubt about specifications or prices, we will welcome the opportunity to answer your questions.

Orders are subject to final acceptance by the Sales Office at Buffalo, New York, at prices prevailing at the time of shipment.

### Prices

All prices, deliveries, and terms of sale listed are subject to change without notice.

When an outfit is ordered without an item regularly included, the price of the excluded item will be allowed, except that no allowance will be made for objective boxes, stage clips, substage glasses, immersion oil, or instrument covers.

Federal, State, City, or other taxes imposed on the sale, lease, or other transfer, use, or consumption of any article listed herein are to be added to the prices quoted.

### Packing and Boxing

Except as otherwise noted, prices listed include cost of packing with cartons and boxes for inland shipments.

### Terms

Orders, except repairs, will be shipped F.O.B. destination in any of the forty-eight states of the U. S. A. and the District of Columbia with carrier to be chosen by us. Terms are Net 30 Days.

To avoid delay, purchasers who have not had an account with us should accompany their first order with commercial references or remittance.

C.O.D. shipments will be arranged if order is accompanied by funds which will adequately take care of shipping charges both ways.

The customer assumes responsibility for payment of shipping charges on merchandise sent on consignment.

### Guarantee

We guarantee all merchandise of our manufacture to be free from defects in either material or workmanship, to a degree consistent with the high standards of quality established and maintained in Spencer instruments.

### Claims for Shortage, Exchange, Etc.

We use extreme care in selection, checking, rechecking, and packing to eliminate the possibility of error.

If discrepancies are discovered, claims should be made immediately.

All packing should be examined very carefully to insure that no small items are overlooked.

Claims for damage in transit should be made to the transportation company, as our responsibility ceases with the safe delivery in good condition to the carrier.

### Returning Material

Our customers are requested to communicate with us before returning any goods. After arrangements have been made for the return, the material should be plainly tagged with the sender's name and address.

Please indicate the date of invoice and number on which the goods were billed.

### Ordering Replacement Parts

In ordering parts of instruments for replacement or repair, give serial number of the instrument as well as the catalog number and full description.

Whenever possible the broken part should be sent to the factory.

### Illustrations

Because improvements are being made in our instruments from time to time, the illustrations may not in each case conform in every minor detail to the specific construction of the completed product.

We will welcome opportunities to supply photographic prints or electros of our equipment for use in illustrating publications.



## Outstanding Features of Spencer Microscopes

The quality of a microscope is judged by its optical performance. In the early days, Charles A. Spencer produced, in his small workshop, the finest objectives of his time.

Today, to maintain leadership, a research and development staff continues to devote its efforts to producing the finest in microscope optics. Correspondingly, it is improving the precision of mechanical features in order to obtain the fullest advantages of the optics and, at the same time, afford the user maximum comfort and convenience.

### Stand

The stands of all Spencer microscopes are well proportioned and stable. The arm, cast or forged from metals which insure permanent rigidity, like an optical bench, maintains alignment of the optical parts. The curve of the arm provides a large area on the stage for manipulation.

The taper axle inclination joint is designed so that, even after years of use, it will hold the body of the instrument in any position from the vertical to the horizontal. This security with which the instrument is held, together with the smoothness of movement, is due to the fact that the joint consists of a fiber insert bearing against a brass forging.

Stability is assured by the well proportioned horseshoe base.

### Coarse Focusing Adjustment

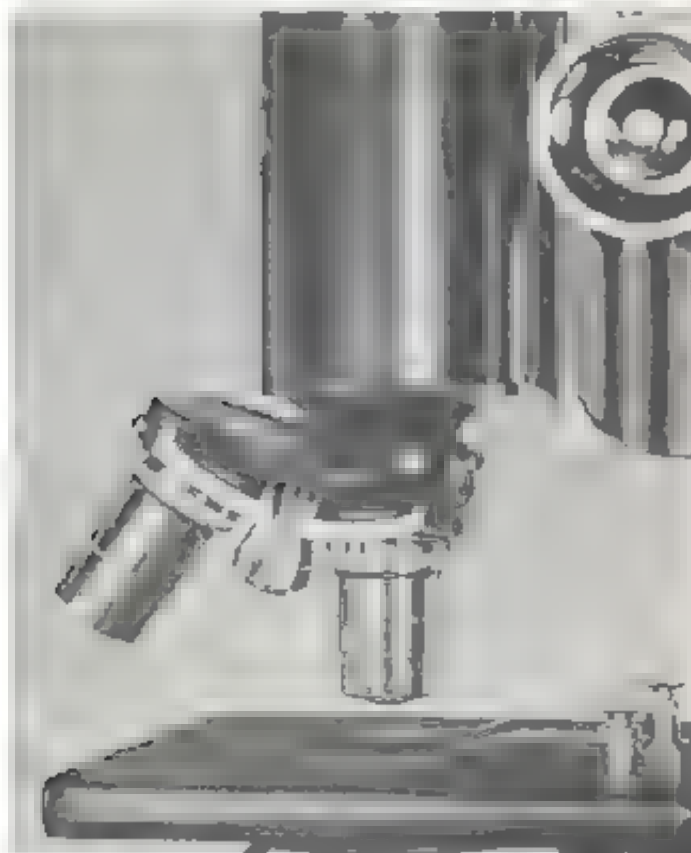
The coarse focusing adjustment mechanism used on all Spencer microscopes is engineered to provide smoothness and ease of movement for the life of the in-

strument. The handlapped slideways of forged brass sliding on extruded brass are milled to provide oil grooves which retain the lubricant and trap dust and abrasive particles.

The rack and pinion are diagonally cut and incorporate an involute tooth design which provides both maximum strength and smooth, precise action.

*Smooth operating, hand fitted coarse adjustment bearings with oil grooves.*





### Fine Focusing Adjustment

The fine focusing adjustment is a feature which allows the user to make very fine adjustments to the focus of the microscope. This is achieved by a small, circular knob located on the side of the microscope body. The knob is designed to be turned with the thumb and forefinger, providing a precise and controlled movement of the stage or objective lenses. This feature is particularly useful when working with high-magnification objectives, where even the slightest change in focus can significantly affect the quality of the image.

### Dual Cone Nosepiece

The dual cone nosepiece is a unique design that allows the user to switch between two different objective lenses without the need to rotate the nosepiece. This is achieved by having two separate cones of light, one for each objective lens, which are positioned opposite each other. The user can simply flip a switch or lever to select the desired objective lens, and the microscope will automatically adjust the focus to compensate for the change. This design is particularly useful for applications where the user needs to switch between different magnifications frequently, as it allows for a much faster and more convenient operation.

### Stage

The stage is made of solid, durable Haxelite which is resistant to all common reagents and will not warp or fade. It is provided with chromalamp plates, spring steel clips. The great distance from the stage to the objective lenses allows for large specimens to be viewed without the need for special adapters.





## Optics

For standard research and experimentation of Spectroscopes, objectives and condensers designed to work together and when

best results. Eyepieces are truncated cone shape for ease of observation, and for those wearing glasses. Objectives marked with the equivalent aperture and initial

illumination shown in the column. These sections, developed out of the experience and good practice of past years may be varied to fit particular requirements. See the corresponding Microscope Accessories section.



### Standard Optical Units

APPROXIMATION	Designation	Objectives Achromatic	Eyepieces	Magnification	Condenser
Elementary	B	10-4	10X Huygenian	100-400X	No condenser
	D	16-4	6X-10X Huygenian	60-400X	No condenser
	DA	25-64	6X-10X Huygenian	70-400X	No condenser
Intermediate and astronomical and average illumination	F	10-4	10X Huygenian	100-400X	Slide type condenser with A.C. filter
			Huygenian		with A.C. diaphragm
	PA	25-64	6X-10X	70-400X	
High magnification		1X-10-4	6X-10X	1	
	PA				



### Fork-Type Substage

The fork-type substage, an exclusive Spencer feature, is standard on all advanced laboratory microscopes. It allows for smooth and precise

work with the rest of the optical system. The substage condenser is held firmly in place by means of two spring plungers. This feature also provides an easy interchange of the condenser and the dark field illuminator. All fork-type substages are actuated by diagonal rack and pinion for focusing the illuminator.

### Finish

All Spencer microscopes are finished in soft black enamel and chromium plate, which enhances not only their beauty, but

also their durability. The black parts are baked enamel that is impervious to most laboratory reagents. The plate parts are multiple coated—the final coat being chromium.

### Cabinet

The microscope is regularly supplied in a well-made hardwood cabinet.

Black cathartite. The cabinet is equipped with lock and key and features for extra objectives and eyepieces. Also available for medical microscopes is a cathartite covered carrying case equipped with lock and key, side box and rings for additional objectives, haemocytometer and accessories. An interesting booklet containing many useful suggestions for the most effective use of the microscope is furnished with every Spencer microscope.

*Leatherette-covered hardwood cabinet shown*





## Elementary and Routine Laboratory Microscopes

An increasing number of school science laboratories are providing microscopes for elementary and in the following pages

the Engineering and Research Divisions in designing these instruments. They are designed to be as simple as possible.

The No. 66 is a complete instrument, light, simple and easy for students to use. It is available at a cost of \$10.00.

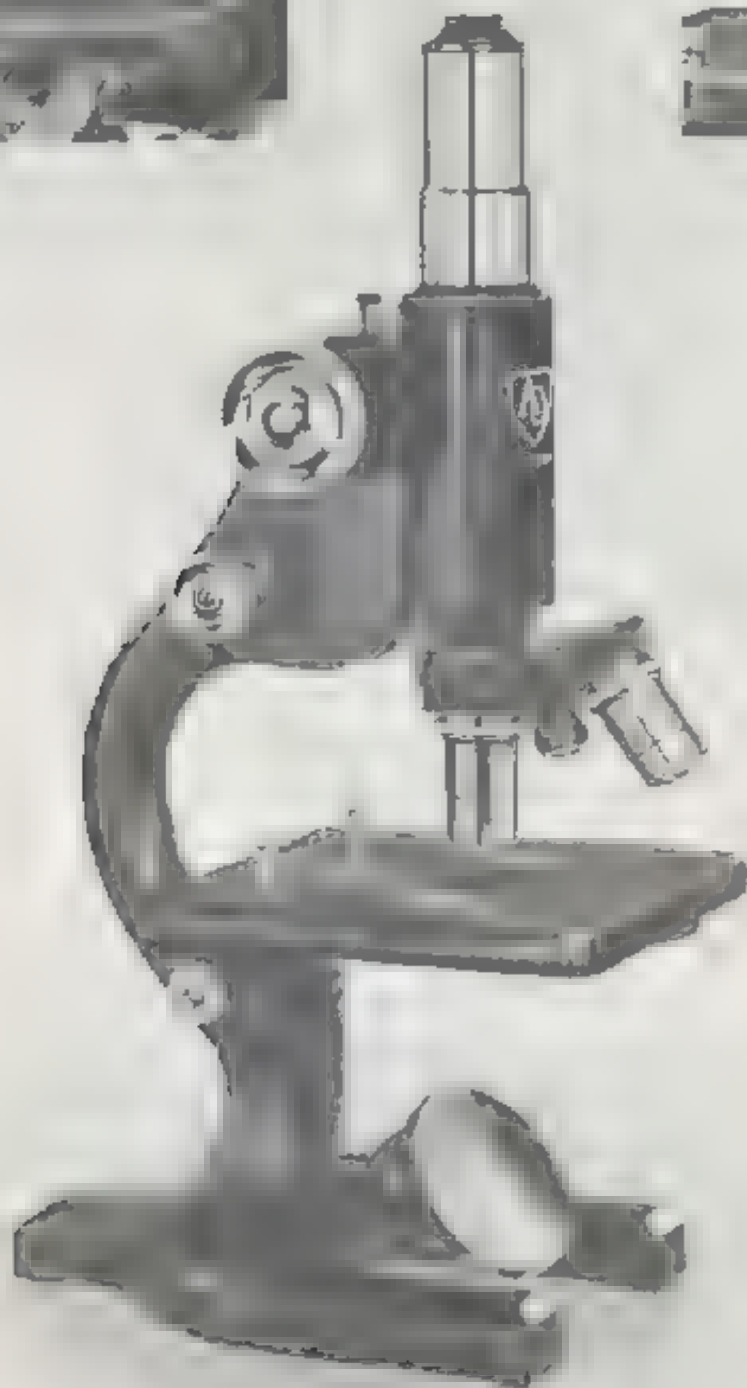
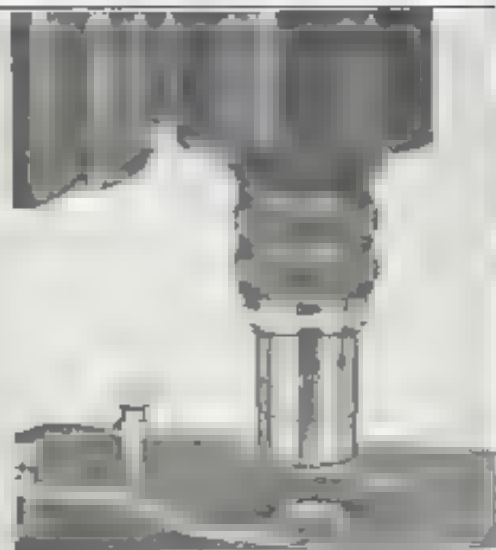
The No. 63 is a heavier model which can be equipped for more advanced laboratory work.

Both microscopes have the advantages

See section on Stereoscopic Microscopes which can be used for elementary work.









## Spencer Elementary Laboratory Microscope No. 66

The Spencer No. 66 Microscope is particularly suited for use in elementary biology courses. It is a standard sized instrument for laboratory work, moderately priced and equipped with both coarse and fine adjustments.

The eyepieces and objectives are the same as those offered on more expensive instruments and all of the mechanical parts are of high grade workmanship.

### STAND

The stand has a forged brass arm with a standard taper axle inclination joint, and a heavy cast base that insures stability in all positions.

### RACK AND PINION COARSE ADJUSTMENT

This adjustment has a jagged cut rack and spiral pinion of involute tooth design. A mechanical stop is provided to prevent breaking of the cover glass when focusing with 16mm objectives.

### MICROMETER SCREW TYPE FINE ADJUSTMENT

The ungraduated fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass.

### BODY TUBE

The body tube has a length of 160mm, a diameter of 37mm, and accommodates standard diameter eyepieces. It has a standard society thread and accommodates all standard nosepieces, objectives and arm for accessories.

### DUAL-CONE NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective unless otherwise specified.

### STAGE

The solid, durable Bakelite stage 110mm x 115mm is resistant to most common reagents and will not warp or fade. It is provided with durable chromium plated spring steel stage clips.

### REVOLVING DISC DIAPHRAGM

The easily operated solid plate has a rack stop to index each of the 10 positions. A CONDENSER IS NOT AVAILABLE FOR THIS INSTRUMENT.

### MIRROR

The standard diameter concave mirror is mounted on a fork attached to the mirror bar. The fork and the mirror bar are adjustable.

The mirror has a black baked enamel and chromium plating.

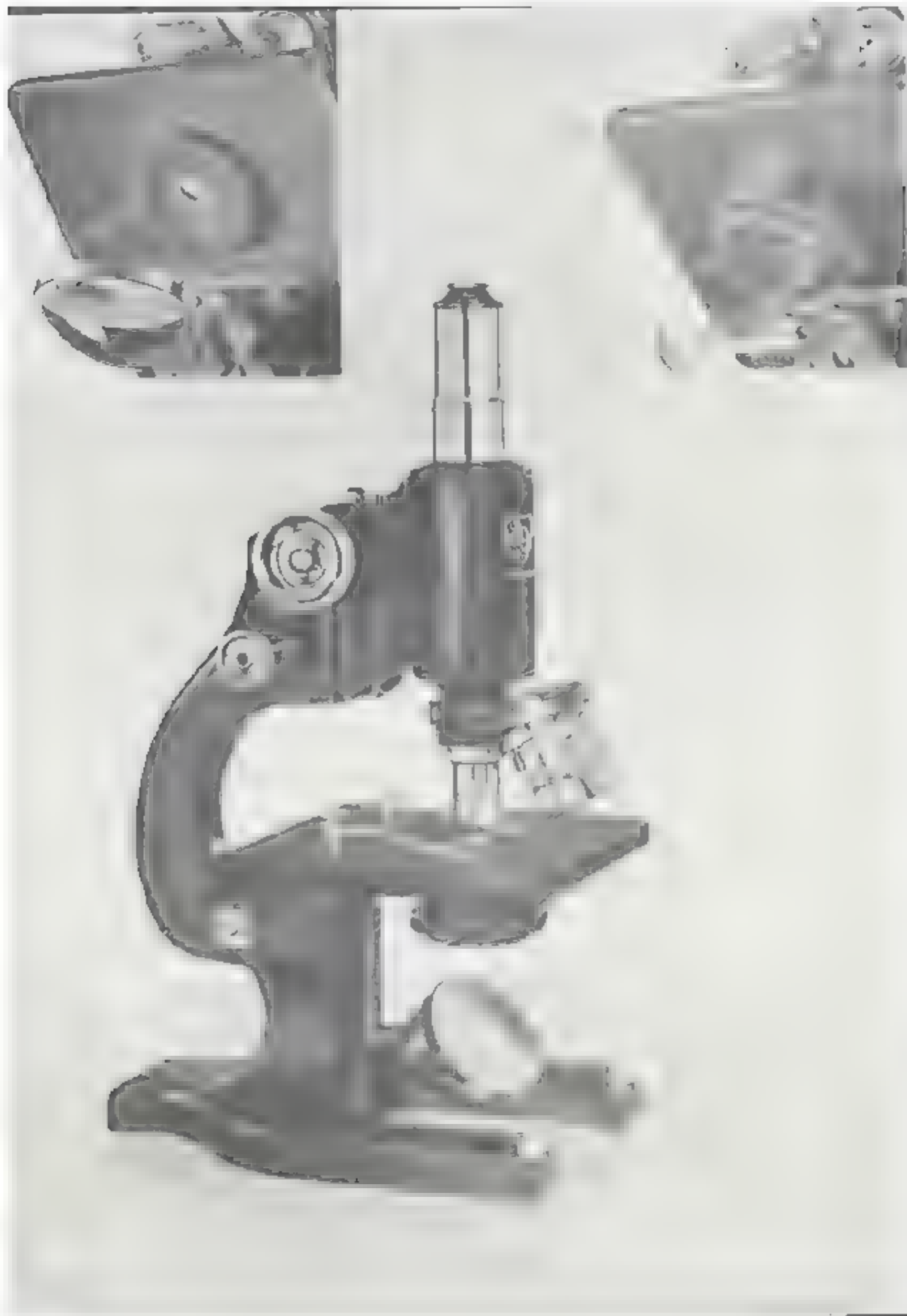
### CABINET

A decorative covered hardwood cabinet with a lock and key and plastic boxes for objectives is provided for each microscope. The instrument can also be supplied without cabinet if desired.

*Top Left: Revolving Disc Diaphragm*

*Top Right: Adapter holds single objective*

*Below: Elementary Laboratory Microscope No. 66A*







## Spencer Routine Laboratory Microscope No. 63

The Spencer No. 63 Microscope is a large, sturdy instrument which can be adapted or constructed in more advanced

The eyepieces and objectives are the same as those offered on more expensive instruments, and all of the mechanical parts are of high grade workmanship.

The Abbe type N.A. 0.66 condenser available with the No. 63 is of particular value. This condenser has been developed for use on the microscope when an oil immersion objective is not used. It makes it possible to take advantage of the full numerical aperture of the 4mm. objective and at the same time get full, even illumination of below power objectives with

### STAND

The stand has a forged brass arm with a standard taper axle inclination, 3 in. and a heavy cast base that insures stability in all positions.

### RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop which is provided prevents breaking of the cover glass when focusing with 46mm. objectives.

### MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass. It is graduated in 2.5 micron increments.

### BODY TUBE

The large body tube is 160mm. in length, 45mm. in diameter and accommodates standard diameter eyepieces. It has a standard society screw thread to accept all standard nosepieces, objectives and other accessories.

*Top Left: Lens Diaphragm*

*Top Right: Abbe type condenser, N.A. 0.66 with iris dia-*

*Below: Routine Laboratory Microscope No. 63H*

### DUAL CONE NO REFLECT

The exceptionally large bearing surface provided by the opposing cone bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective provided unless otherwise specified.

### STAGE

The solid, durable Bakelite stage, 125mm. square, is resistant to all common reagents and will not warp or fade. It is provided with spring steel stage clips that are not easily damaged.

### DIAPHRAGM

An iris diaphragm, with corrosion resistant bronze leaves directly beneath the stage opening, provides the illumination control when a condenser is not supplied. This diaphragm can hold a substage condenser.

### CONDENSER

When work with oil immersion objectives is not contemplated, the N.A. 0.66 condenser with iris diaphragm in a spiral focus sleeve is supplied with optical oil lens, and iris condenser. When an oil immersion objective is provided, the N.A. 1.25 condenser is supplied.

### MIRROR

The standard diameter mirror, which is concave on one side and plane on the other, has a center stop that provides uniform illumination.

### FINISH

The finish is black baked enamel and chromium plating.

### CABINET

A leatherette covered hardwood cabinet, with a lock and key and plastic boxes for objectives, is provided for each microscope. The instrument can also be supplied without cabinet if desired.



## Elementary Laboratory Microscopes

Group "A" Microscopes for elementary instruction and simplest routine work

Group "B" More flexible Microscopes for elementary work which can be equipped with condenser at a later time for more advanced work

Group "C" Microscopes for more advanced instruction, including special equipment for cytology, histology, Entomology

Table 1

	Car No.	Nose piece	Refracting Objective	Eye piece Magnification	Range of Magnification	Substage Equipment	Stage
C	60B	Double	16-4mm	10X	100-440X	Revolving Disc Diaphragm	"
B	60B	Double	16-4mm	6X-10X	60-440X		"
P A	60DA	Triples	15-16-4mm	6X-10X	60-440X		
C F	63B	Double	16-4mm	10X	100-440X	T. & Diaphragm	"
		Double	16-4mm	6X-10X	60-440X		
		Triples	15-16-4mm	6X-10X	60-440X		
		Double	16-4mm	10X	100-440X	Abbe type condenser N.A. 0.60* with graduated iris diaphragm in special focus sleeve	Plain 125x 25mm
		Lathe	16-4mm	6X-10X	60-440X		
		Triples	15-16-4mm	6X-10X	60-440X		
		Triples	16-4mm 15-16-4mm	6X-10X	60-440X	Same as above but with N.A. 1.25 condenser	
	64MB	Triples	16-4mm 15-16-4mm	6X-10X	60-440X	Same as above but with N.A. 1.25 condenser	Mechanical

\*1.25 immersion objective is to be added later. N.A. 1.25 condenser should be specified at no charge in price



## Biological, Medical and Advanced Laboratory Microscopes

Medical and Advanced Laboratory Microscopes have been developed to provide a comprehensive range of magnifications, and convenience needed in medical, public and school laboratories. These are the Spencer microscopes that are usually selected by medical students for their college training and subsequent practice. With individualized optical equipments they meet the requirements of all medical colleges.

Years of experience have determined the best possible range of magnification and resolution for different types of observa-

In addition to the three objectives, (H) equipment just described, two and one-half inch objectives are listed. There are

A low power finder or "scanning" lens may be added to the (H) equipment and is recommended where frequent examination of gross specimens is necessary. Such a combination is required by some world then be used. See the chart of optical combinations in the next section.

The No. 33, monocular series are microscopes which provide all the essential features for advanced work. The binocular body cannot be adjusted to these adjustments.

The No. 13 microscopes are designed to hold the binocular bodies, either vertical or inclined and the large stage-

a simple, positive screw clamps the bodies in place, and an adjustable spring tension is provided to compensate for the difference in weight

bodies and to assure positive action of the fine adjustment when the instru-

### Various Spencer Microscope Accessories

slides are available for counting or measuring. Teaching accessories such as Demonstration Eyepiece and Camera Lucida may be used.

16mm (low dry) 13X  
4mm (high dry) 44X and  
18mm oil immersion 95X

It has a 1.40 N.A. oil immersion objective

the front element is removed the objective

at 4X

The 4mm objective has a N.A. of 0.60 which provides long working distance for blood counting or tissue examination.

and a power

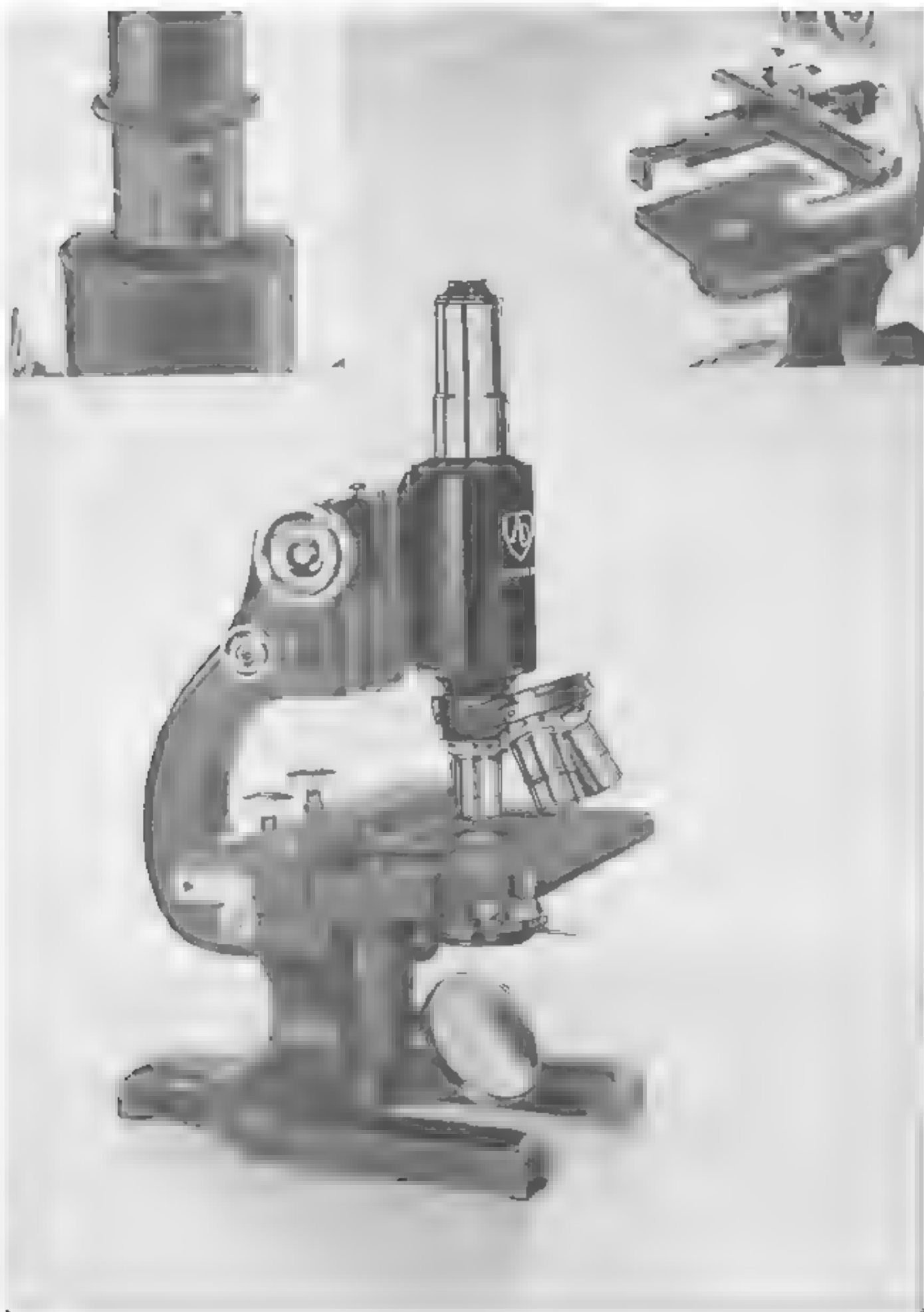
provided by the various combinations of eyepiece and objective range from 24X to 95X.

## Spencer Laboratory Microscope No. 33

The Spencer No. 33 Microscope is completely equipped and suitable for most observations with transmitted light. With various accessories, it meets the requirements of all medical schools, and is selected

by a high percentage of medical students. It is a standard instrument for advanced biological work. Following are some of the features of construction.







## STAND

The stand has a forged brass arm with special tapet axle inclination cone and a heavy cast base which insures stability in all positions.

## RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop prevents racking down into the cover glass when focusing with 16mm. objective.

## MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment, graduated in 25 micron intervals, automatically compensates for wear and ceases to function if the objective contacts the cover glass.

## BODY TUBE

The body tube has a length of 60mm., a diameter of 45mm. and accommodates standard diameter eyepieces. It has standard Society's screw thread which is common to all objectives and nosepieces of standard microscopes.

## DUAL-CONE REVOLVING NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and an automatic compensation for wear. The nosepiece may have three or four openings, depending upon the number of objectives specified.

## STAGE

The solid, durable Bakelite stage, 25mm. square, with a distance of 105mm. from arm to optical axis, is set square to all common reagents and will not warp or fade. It is provided with chromium plated spring steel clips.

Top Left: Graduated adjustable draw tube is available.

Top Right: Adjustable mechanical stage, with or without graduations, may be mounted on a plain stage micrometer.

Bottom Left: Achromatic objectives are corrected for 60mm. tube length and 0.18 NA.

## PLAIN MECHANICAL STAGE

When M-1 is listed in the catalog number, this stage is included as standard equipment. It provides the range of movement necessary for complete examination of objects on slides as large as 3 X 2 inches. It can be racked off when a plain stage is desired.

## RACK AND PINION FORK TYPE SUBSTAGE

The fork-type mount of this substage provides an easy interchange of substage parts and assures accurate alignment of substage equipment with the rest of the optical system. Focusing of the condenser is accomplished with ease and precision.

## CONDENSER

The Aobe type diaphragm substage condenser has a filter holder and an iris diaphragm with heavy bronze leaves. The condenser can be removed quickly from the fork-type mount for cleaning or replacement by the dark field condenser.

## MIRROR

The standard diameter mirror mounted in a fork for tilting to any desired angle, is concave on one side and plane on the other. It may be removed or cleaned or use of substage lamp.

## ILLUMINATION

For ease in observation, especially for those who wear glasses, the illumination is available for both eyes.

## OBJECTIVES

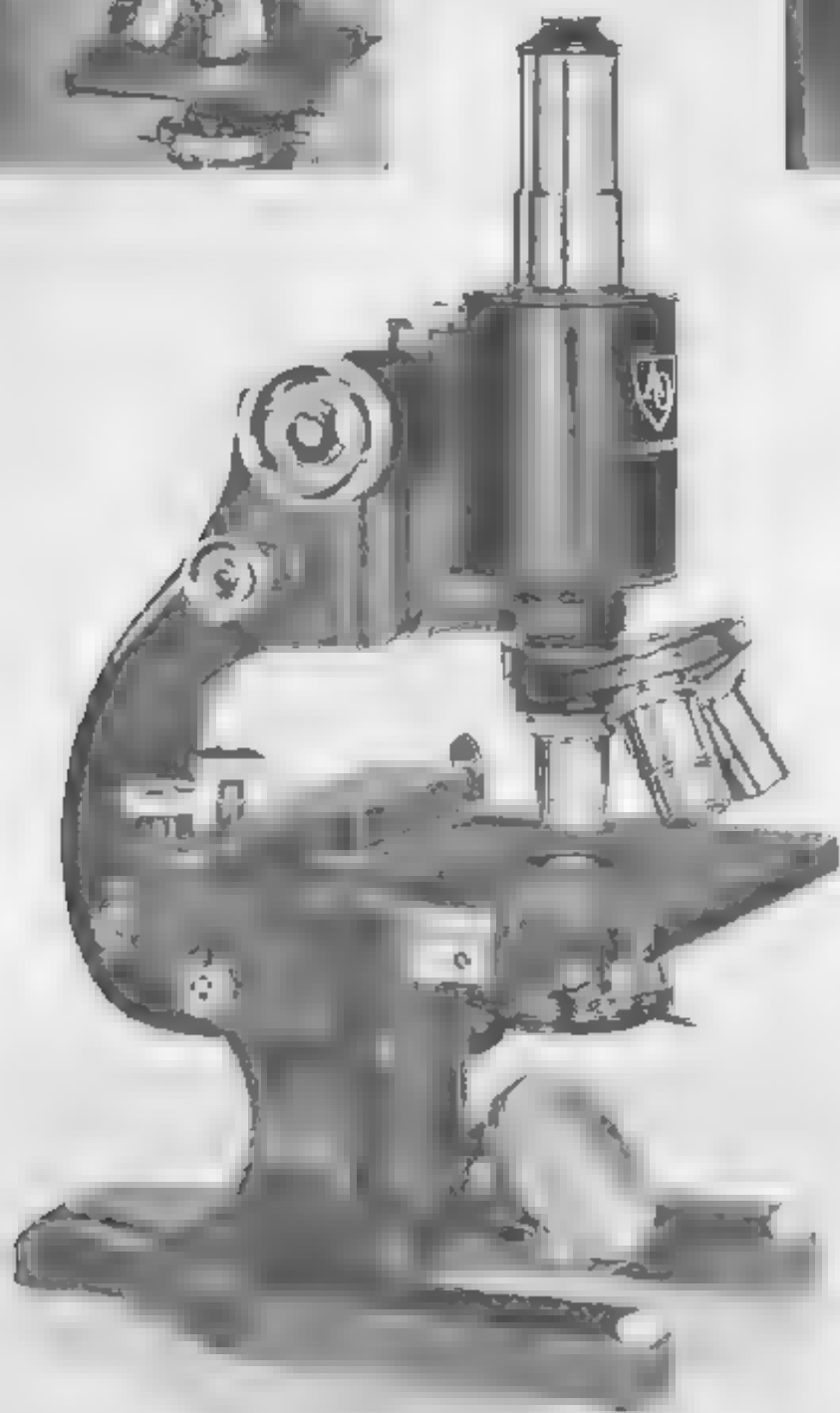
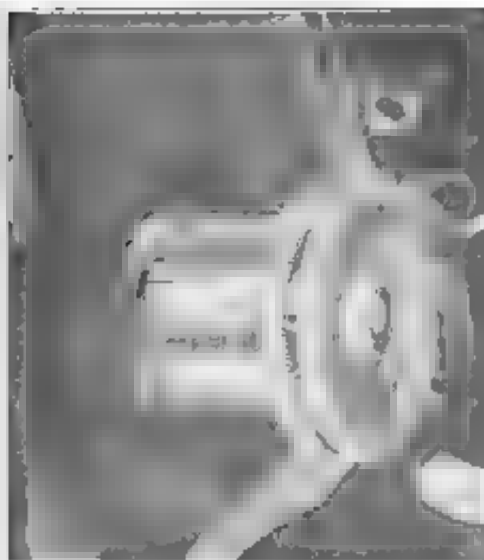
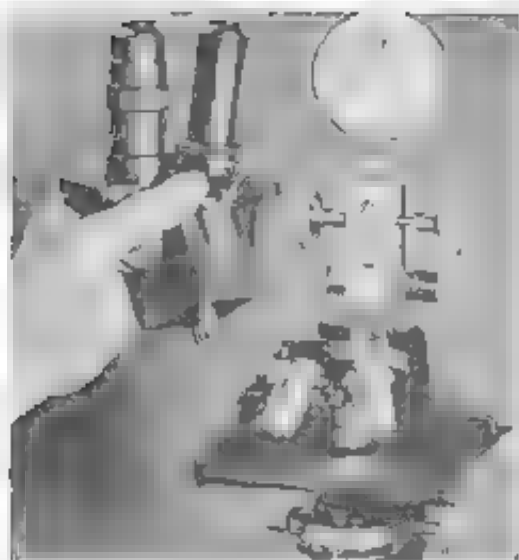
The achromatic objectives are corrected for 60mm. tube length and 0.18 NA.

## FINISH

The finish is baked black enamel and chromate plating.

## CABINET

The cabinet is covered in hard wood cabinet cloth. It has provisions for additional accessories available in a black leatherette covered carrying case equipped with side box and rings for additional objectives.





## Convertible and Binocular Microscopes No. 13

The Spencer No. 13 Microscope stands contain all of the desirable features of No. 33 and in addition have provision for the interchange of body tubes.

The use of binocular microscopes is preferred in research. Their use is rapidly increasing in the routine work that requires prolonged periods of observation. No. 13 can be purchased with:

- 1 The large monocular body with either fixed or graduated draw tube
- 2 Vertical Binocular Body
- 3 Inclined Binocular Body

These bodies are interchangeable.

The growing preference for Spencer Binocular Microscopes can be attributed largely to the unusual ease and comfort afforded by the convergence of the eyepieces. The prism system of Spencer binocular bodies directs the pencils of rays to the eyepieces at an  $8^\circ$  angle—a natural convergence. If the user refers to a text, or reaches for a slide, he will find it unnecessary to re-accommodate to study the field in his microscope. The angle of convergence of his eyes is about the same. There are very few requests for bodies with parallel eyepiece tubes but they can be supplied if desired.

Two types of binocular bodies are available—the vertical and inclined. The latter has the eyepiece tubes tilted  $30^\circ$  from the vertical so that an easy, natural posture can be maintained when using the instrument.

On both types of bodies, interpupillary adjustment can be made by means of a knurled ring at the base of the right eyepiece tube. Graduations permit easy resetting for the individual user. On the left tube is a graduated, knurled collar for adjusting the length of the eyepiece tube to compensate for difference in vision between the eyes.

*Top Left: Binocular or monocular bodies are easily interchanged on a No. 13 Microscope.*

*Top Right: Fine adjustment of No. 13 Microscope is graduated in units of 2 microns.*

*Bottom: Convertible Microscope No. 13MAH.*

### STAND

The stand has a forged brass arm with a special taper axle mechanism for it, and a heavy cast base that assures stability in all positions.

### RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonal cut rack and spiral pinion of involute tooth design. A mechanical stop prevents racking down into the cover glass when focusing with 16mm. ob-

### MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment, graduated in 25 micron intervals, automatically compensates for wear and ceases to function when the objective contacts the cover glass.

### DUAL CONE REVOLVING NOSEPIECE

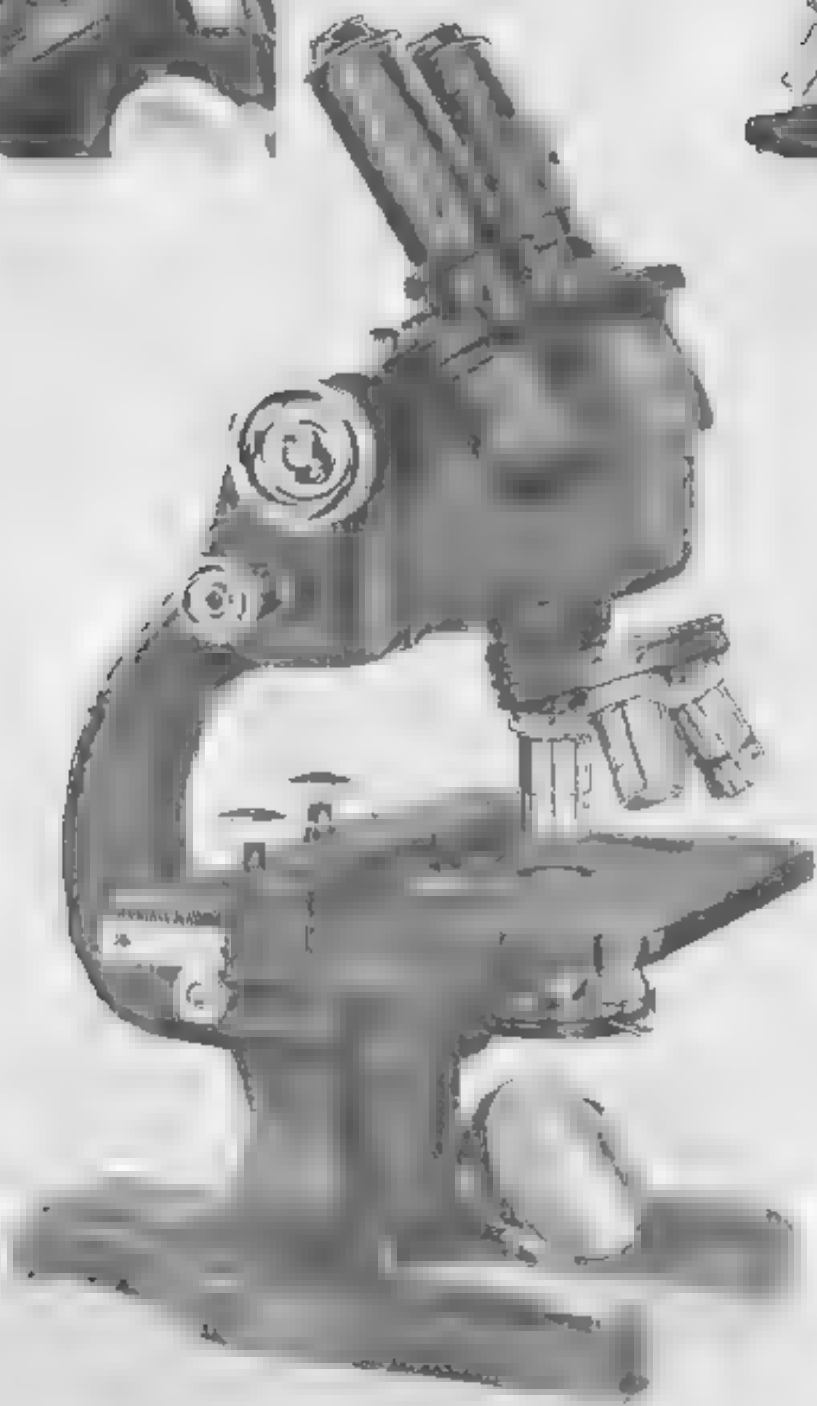
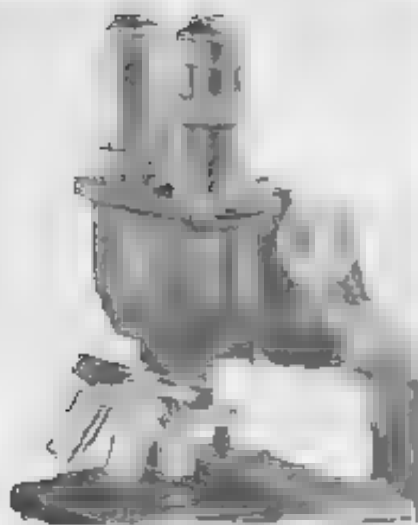
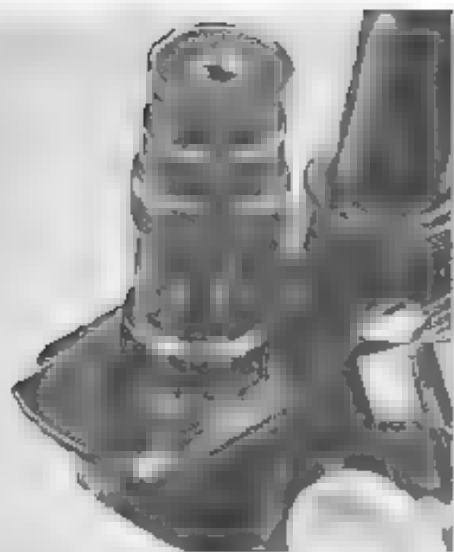
The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece may have three or four openings, depending upon the number of objectives specified.

### STAGE

The solid, durable Bakelite stage, 125mm. square, with a distance of 105mm. from arm to optical axis, is resistant to most common reagents and will not warp or fade. It is provided with chromium plated spring steel

of objects on slides  
of various sizes. It can be  
racked off when a piece is







## RACK AND PINION FORK TYPE SUB-STAGE

The fork-type mount of this substage provides for easy interchange of substage parts and assures accurate alignment of substage equipment with the rest of the optical system. Focusing of the condenser is accomplished with ease and precision.

## CONDENSER

The Abbe type divisible substage condenser has a filter holder and iris diaphragm with heavy bronze leaves. The condenser can be removed quickly from the fork type mount for cleaning or replacement with the dark field condenser.

## MIRROR

The standard quarter mirror mounted in a fork for tilting to any desired angle, is concave on one side and plane on the other. It may be removed for cleaning or use of substage lamp.

## EYEPIECES

For ease in observation, especially for those who wear glasses, the eyepieces are truncated cone shaped. Scales and reticles are available for measuring and counting.

## OBJECTIVES

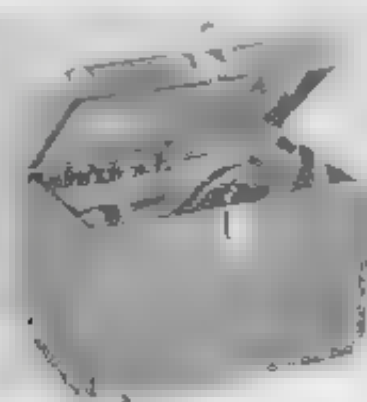
The achromatic objectives are corrected for 160mm tube length and 0.18 cover glass thickness.

## FINISH

The finish is baked black enamel and chromium plating.

## CABINET

The microscope is furnished in a leatherette covered hardwood cabinet that has provision for additional objectives and eyepieces. It is also available in a black leatherette covered carrying case equipped with slide box and fittings for additional objectives, haemocytometer and accessories.



*Top Left: Eyepiece scale and interpupillary distance scale used in adjusting a binocular microscope for proper use.*

*Top Right: Partition binocular body is available as shown on Binocular Microscope No. 13MLB.*

*Below: Binocular Microscope No. 13MLB.*



**GROUP B** Standard medical laboratory instruments cannot be converted to binocular type.

**GROUP C** Medical laboratory microscopes with large monocular or binocular bodies.

		Achromatic oc Obj.	Eye-piece	Magnification	Stage	Body	Substage
	" "	10-4mm.	10X Rev	100-440X	Plain S 125x125mm.	Monocular	Fork-type rack and pinion w. h. Abbe
	" "	16-4mm.	6X-10X day	60-440X	Plain S 125x125mm.	Monocular	Type Condenser N.A. 0.60 at infinity w. h. r.f.s. top view
	" "	25-6-4mm.	8X-10X	30-440X	Plain S	Monocular	
	" "	25-6-4mm.	8X-10X	30-440X	"	"	"
	" "	25-6-4mm.	8X-10X	30-440X	"	"	"
J.P.	3MH	Triplic 16-4mm. 18mm. oil immersion	6X-10X	60-950X	125x125mm	Bino-cular	Condenser with phase contrast
	3MAB	Quadruple 7.5X-16-4mm. 18mm. oil immersion	8X-10X	2	"	"	"
	3AH	Triplic 16-4mm. 18mm. oil immersion	6X-10X Day	60-950X	Plain S 125x125mm	Monocular	Rack & pinion with Abbe N.A. 1.25
	3MAH	Triplic 16-4mm. 18mm. oil immersion	6X-10X	60-950X	Bino-cular	Monocular	
	3AH	Triplic 16-4mm. 18mm. oil immersion	6X-10X Day	60-950X	Plain S 125x125mm	Vertical Bino-cular	Module with 125x4.5 phragm.
J.R.O.J.	3MH	Triplic 16-4mm. 18mm. oil immersion	6X-10X	60-950X	Bino-cular	Monocular	
	3LH	Triplic 16-4mm. 18mm. oil immersion	6X-10X Day	60-950X	Plain S 125x125mm	In-clined Binocular	
	3MALH	Triplic 16-4mm. 18mm. oil immersion	6X-10X	60-950X	Binocular	"	
	3MJW	Triplic 16-4mm. 18mm. oil immersion	10X W.F.	100-950X	Bino-cular Mechanical M	"	

## Special Purpose Microscopes

For some types of work a standard Spencer microscope with special optical or mechanical equipment is recommended. In this section only the special features are described. The stand, focusing oil, objectives, stage, optical quality, etc., and cabinet are identical with those of the advanced laboratory microscopes previously described.

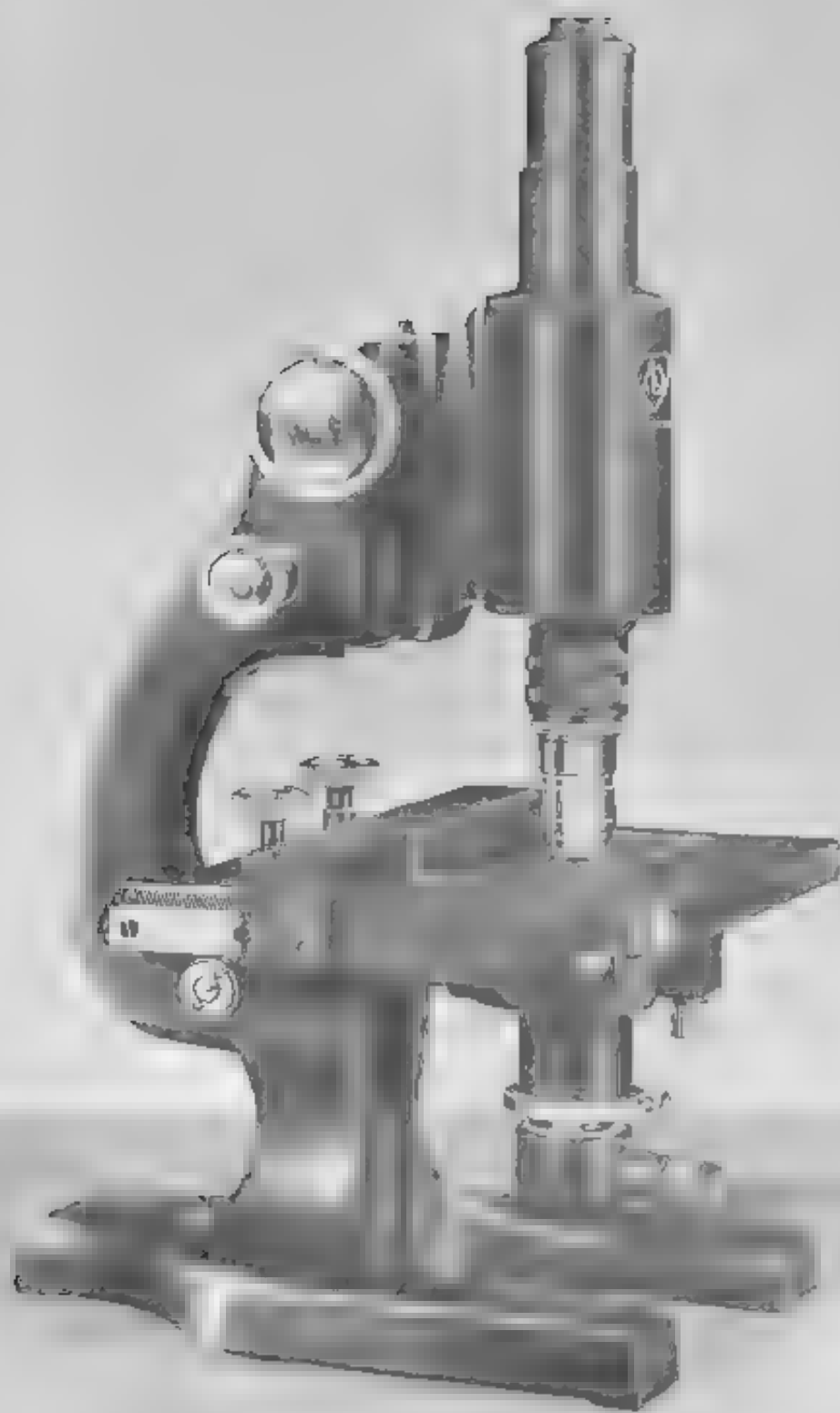
These microscopes are used extensively for specialized medical techniques, analysis of venet. mold, extraneous matter, and adulterants of one kind or another in the industrial laboratory. They are used for counting and measuring microscopic organisms and characteristics. Standard microscopes can sometimes be utilized for these techniques, but it is possible to increase efficiency and to conserve valuable time by using special instruments. Some of the more

popular special purpose and calibrated microscopes are listed and described on the following pages. In each case the advantages of the special microscope are outlined. Some include specific references to approved literature.

INSTRUMENT	PRACTICAL APPLICATION
Dark Field Microscope	Searching for the " " "
Paralogist's Microscope	" " "
Metal Counting Microscope	Issue established in Control of mold, etc.
Water & Sewage Microscope	Population counting
Textile Microscope	" " "







## The Dark Field Microscope

Special microscopes are offered for routine dark field observations. They have been found useful in public health work for the eradication and control of syphilis. Some micro-organisms are so similar in refractive index and color to the medium in which they live that they cannot be seen in the ordinary bright field, but when the illumination strikes them from the sides, and the background is dark, they become self-luminous and are identified easily. The spirochete of syphilis is seen with difficulty by means of a good dark field

These microscopes are designed to do a good dark field illumination without requiring technical skill since the illuminator, the dark field condenser and the objective are permanently aligned and the only manipulation necessary is focusing the objective.

As shown on the drawing, the dark field illuminator forms a hollow cone of light at an angle as to miss the objective. The illuminator, on a slide 1.5 to 1.25 mm in thickness, comes exactly at the apex of the cone of illumination and in this way the self-luminous specimen presents the objective and may be seen.

The substage is hinged at the back end and is held securely at the front by means of a screw with a knurled head. Thus the substage is held in positive alignment with the objective as it is centered at the front.

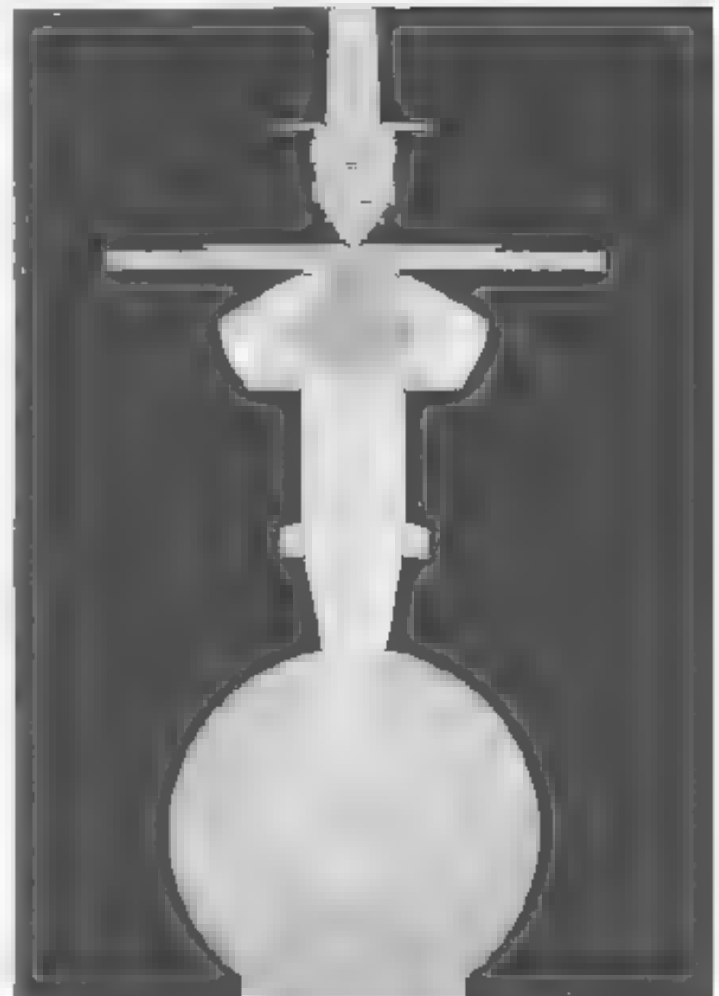
The condenser after it has been used in a immersion contact with the slide

The Spencer dark field illuminator (biprismatic type) has been found to give excellent illumination. It is mounted on the same base that holds the objective.

The illuminator is mounted on the body tube by means of a single nosepiece adapter.

For ease, work and freedom from restriction, the comfort and freedom from restriction experienced with the binocular microscope.

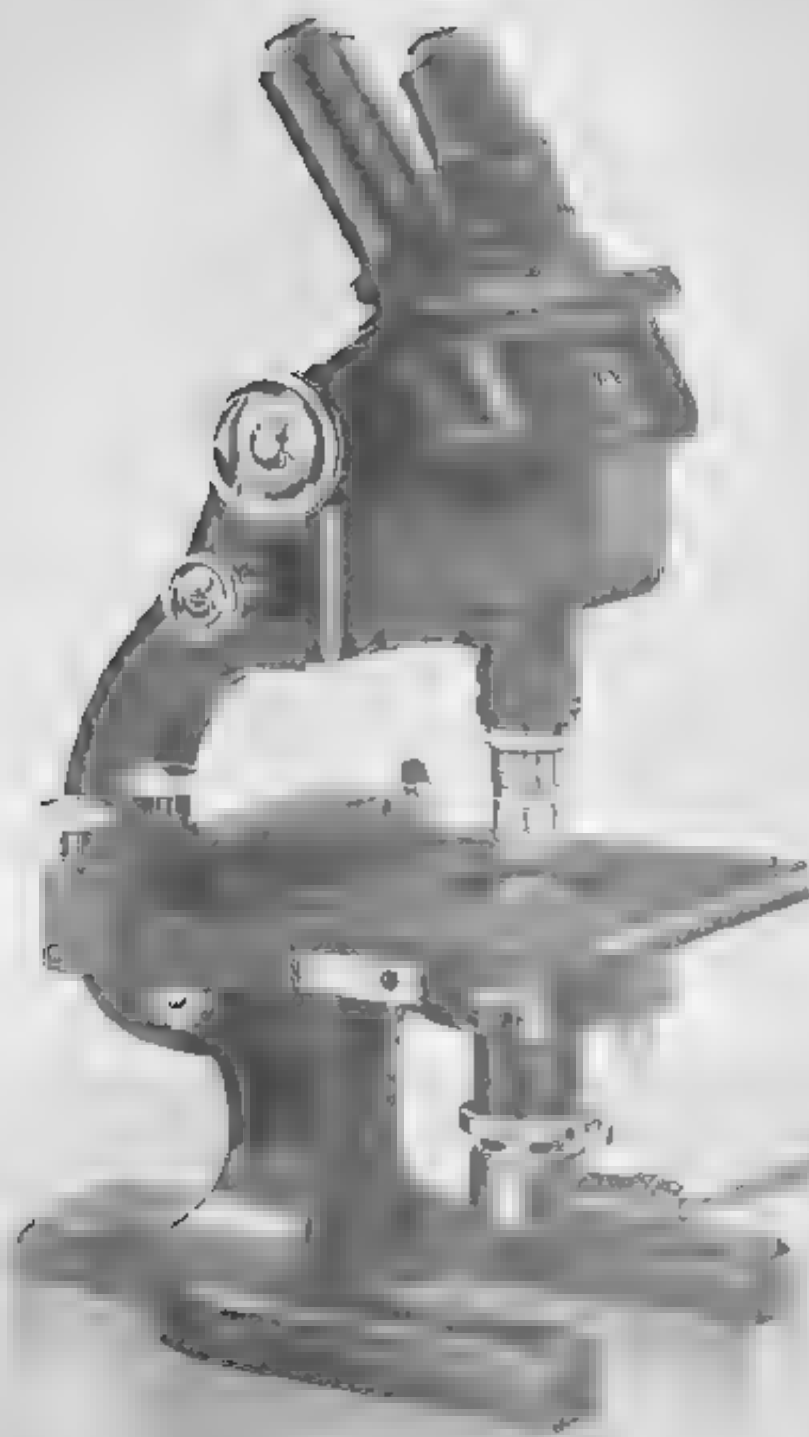
The following table gives a comparison of the five variations of the Special Dark Field Microscopes which are available.



For ease, work and freedom from restriction, the comfort and freedom from restriction experienced with the binocular microscope.

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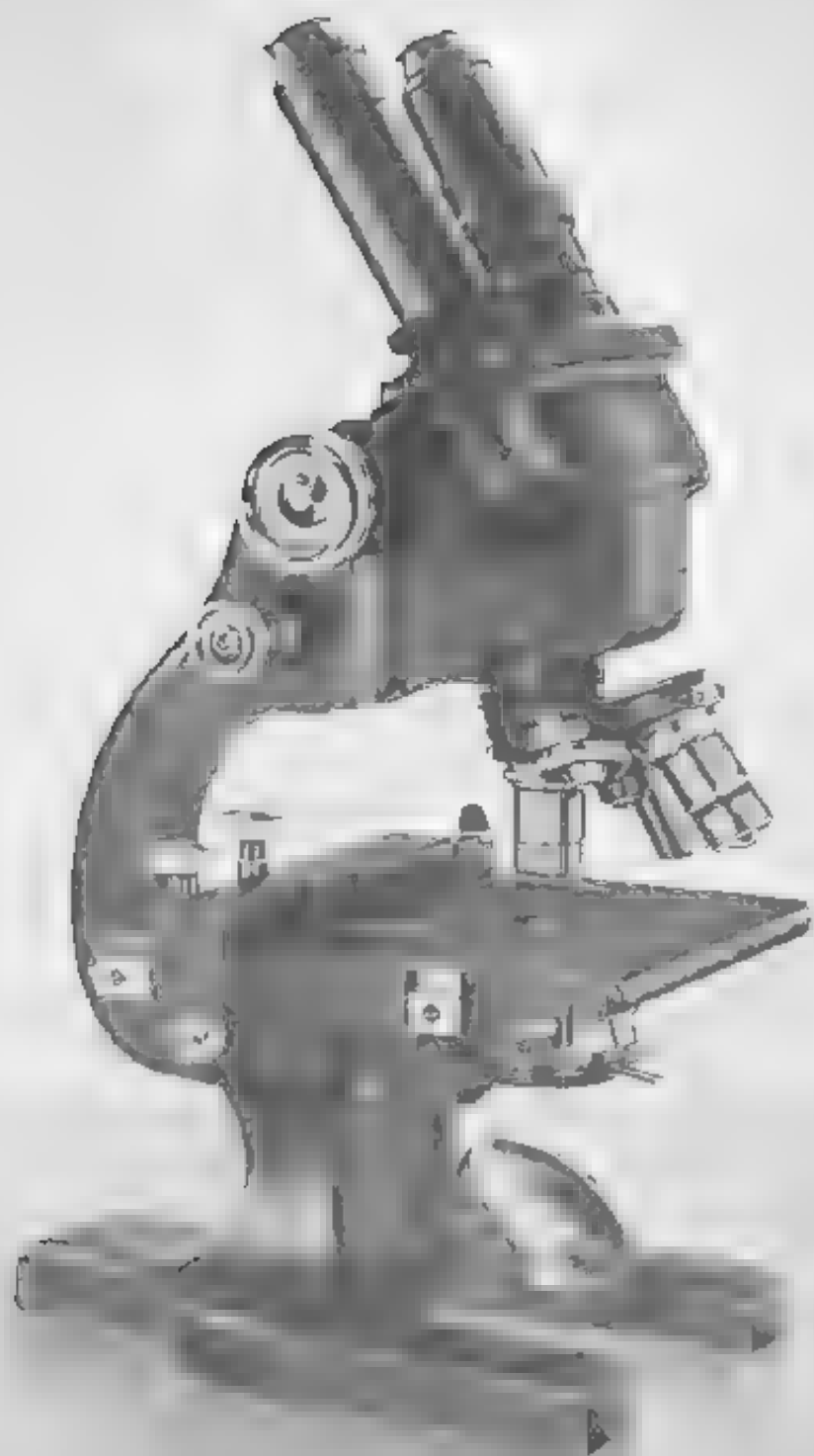
•  $\frac{1}{2} \pi \leq \theta \leq \frac{3}{2} \pi$  :  $\cos \theta \leq 0$  and  $\sin \theta \geq 0$

ARE FILED IN SCOPE

Case No.	Findings	Diagnosis	Prognosis	Treatment	Remarks
1	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
2	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
3	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
4	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
5	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
6	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
7	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
8	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
9	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage
10	1. Hemorrhage with blood clot	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage	1. Hemorrhage

Prof. Spencer Clark Field Misc . . . . . 2 2







## The Pathologist's Microscope

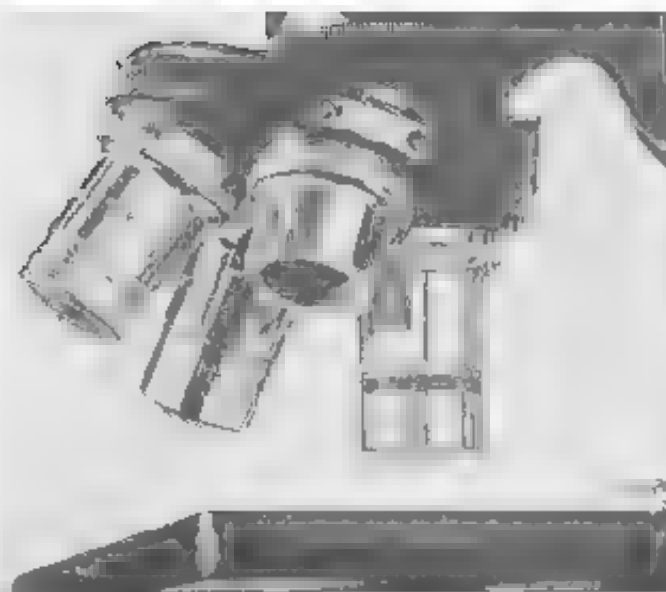
AS a result of the progress in the field of microscopy, the pathologist has been able to observe the structure of tissues and cells in greater detail than ever before.

The Spencer Microscope No. 11 is a binocular microscope with a 3.5X achromatic objective and a 10X eyepiece. It has a built-in stage micrometer and a 10X eyepiece micrometer. The microscope is designed for comfortable viewing and is easy to use.

Microscope No. 11 carries the 3.5X achromatic objective which gives a clear, bright image of the specimen. The 10X eyepiece provides a magnified view of the specimen.

The built-in stage micrometer and 10X eyepiece micrometer are used for making measurements of the specimen. The stage micrometer is used for measuring the length and width of the specimen.

The 10X eyepiece micrometer is used for measuring the thickness of the specimen. The built-in stage micrometer and 10X eyepiece micrometer are used for making measurements of the specimen.



1.4mm. objective in position on No. 11

The Spencer inclined binocular body is designed especially for comfortable posture and vision.

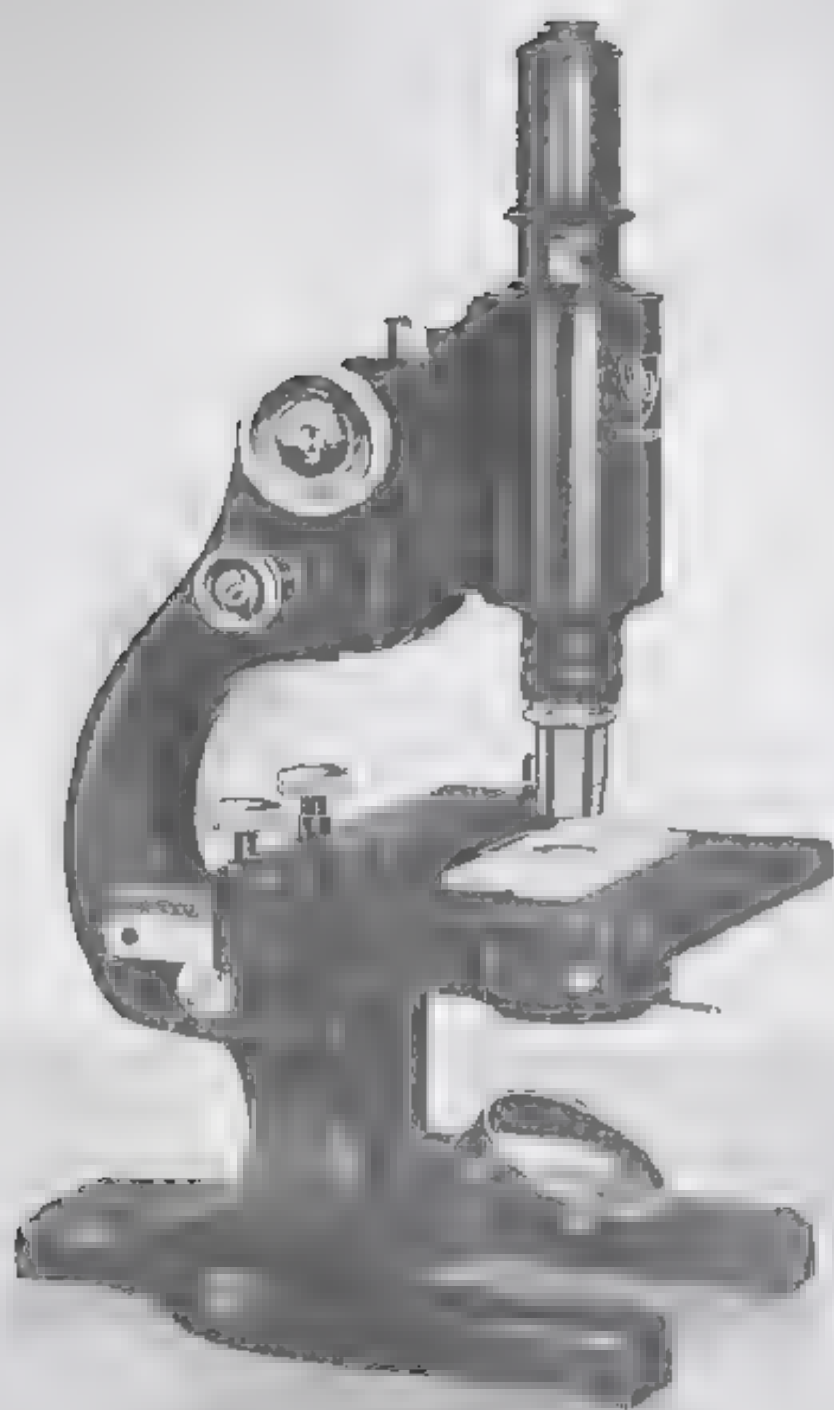
Physiologically it is easy to look into the converging eyepieces and blend the images in a Spencer microscope. The inclined binocular body is also available with parallel eyepiece tubes and may be specified.

Ease of manipulating a specimen is essential in diagnosis of abnormal tissues. The built-in mechanical stage provides the necessary facility.

An eyepiece micrometer with a focusable eyepiece, and stage micrometer, are recommended for making measurements.

### PATHOLOGIST'S MICROSCOPE

Catalog No.	Nose-piece	OPTICS		Magnification	Type of Body	Rack and Pinion Substage	Price
		Achromatic Objective	Eyepieces				
4	Quadruple Revolving	30.2, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	30X to 1900X	Vertical Binocular	With N.A. 1.25 condenser	
11L	Quadruple Revolving	30.2, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	30X to 1900X	Inclined Binocular	With N.A. 1.25 condenser with iris	
10	Quadruple Revolving	25, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	30X to 1900X	Vertical Binocular	With N.A. 1.25 condenser	
11L	Quadruple Revolving	25, 16, 4, 1.8mm. oil immersion	Paired 10X, 20X Wide Field	30X to 1900X	Inclined Binocular	With N.A. 1.25 condenser	





## Mold Count Microscope

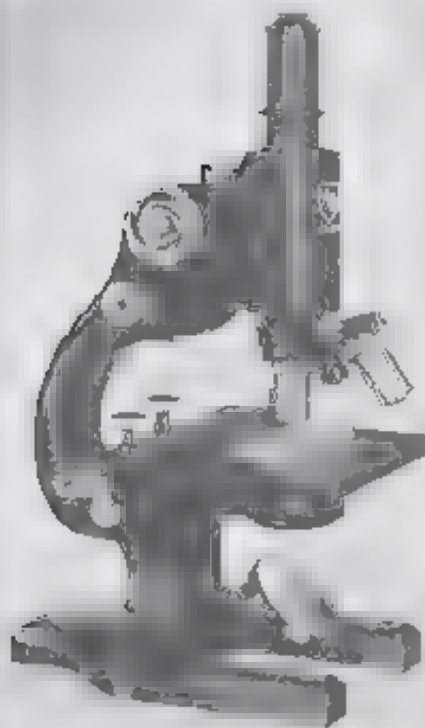
To maintain a high standard of quality in butter, tomatoes, and a number of other products, it is necessary to make routine mold counts. Below are some of the features of Spencer microscopes especially equipped for this work.

1. Pre-arranged to a field diameter of 1.382 mm.
2. Condenser to distribute light evenly.
3. Mechanical stage for systematic examination of specimen.
4. No. 417 Howard Mold Count Chamber is included with each microscope.
5. Green filter is available for use below condenser to increase contrast.

...ual acuity, which thus permits more readings without fatigue.

In the selection of a microscope is for mold count work only, a single form objective is required. No. 417 Howard Mold Count Chamber is included with each microscope. For more extensive study of microscopic organisms the addition of optical equipment to these microscopes is now available. These models with increased usefulness.

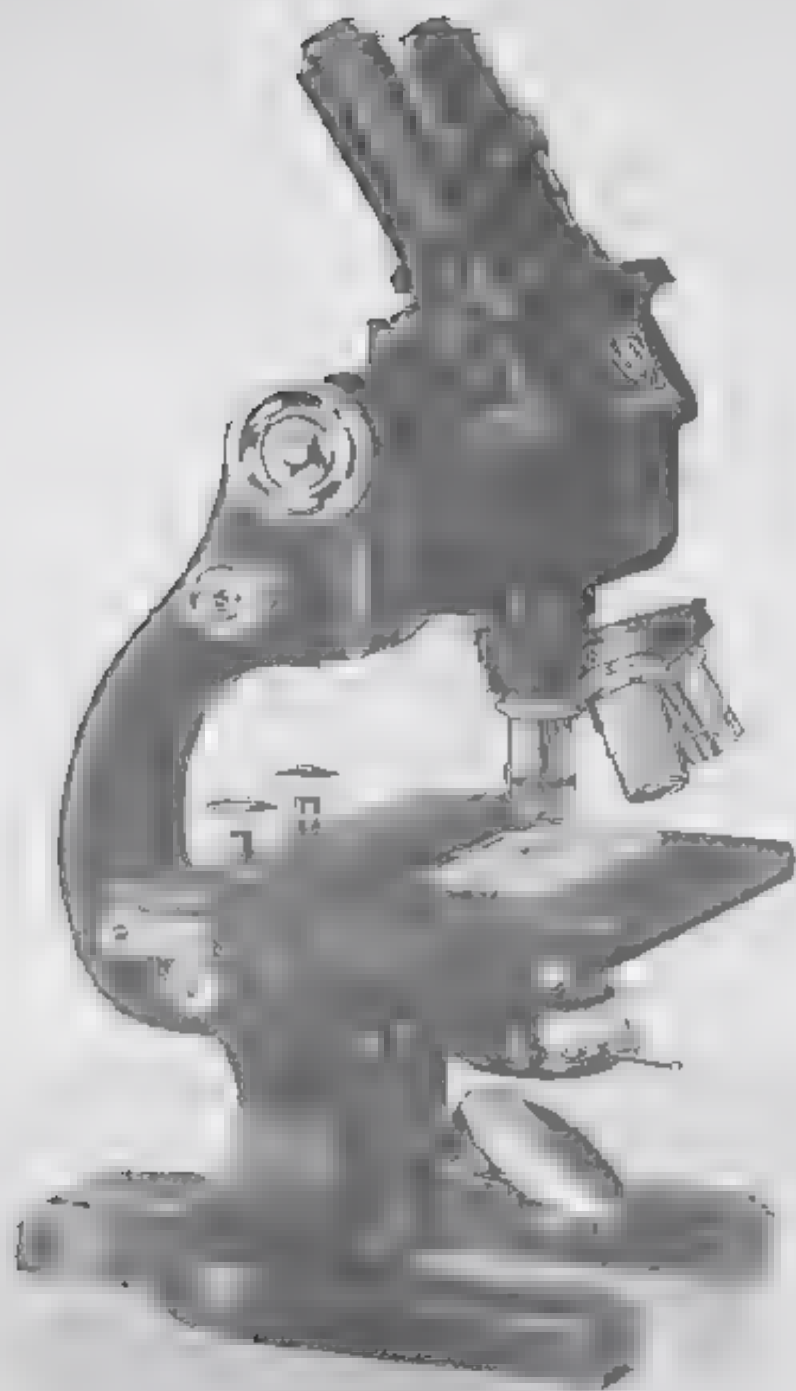
Order Cat. No. 365 for use with monocular microscopes, No. 370 for use with binocular instruments.



Spencer Mold Count Microscope No. 40



Spencer Mold Count Microscope No. 40





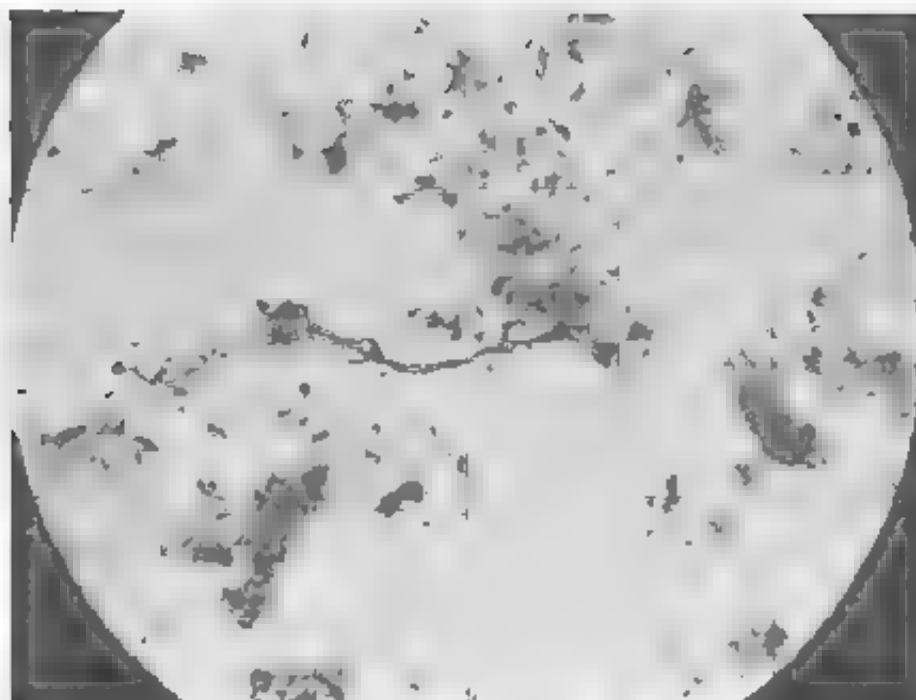
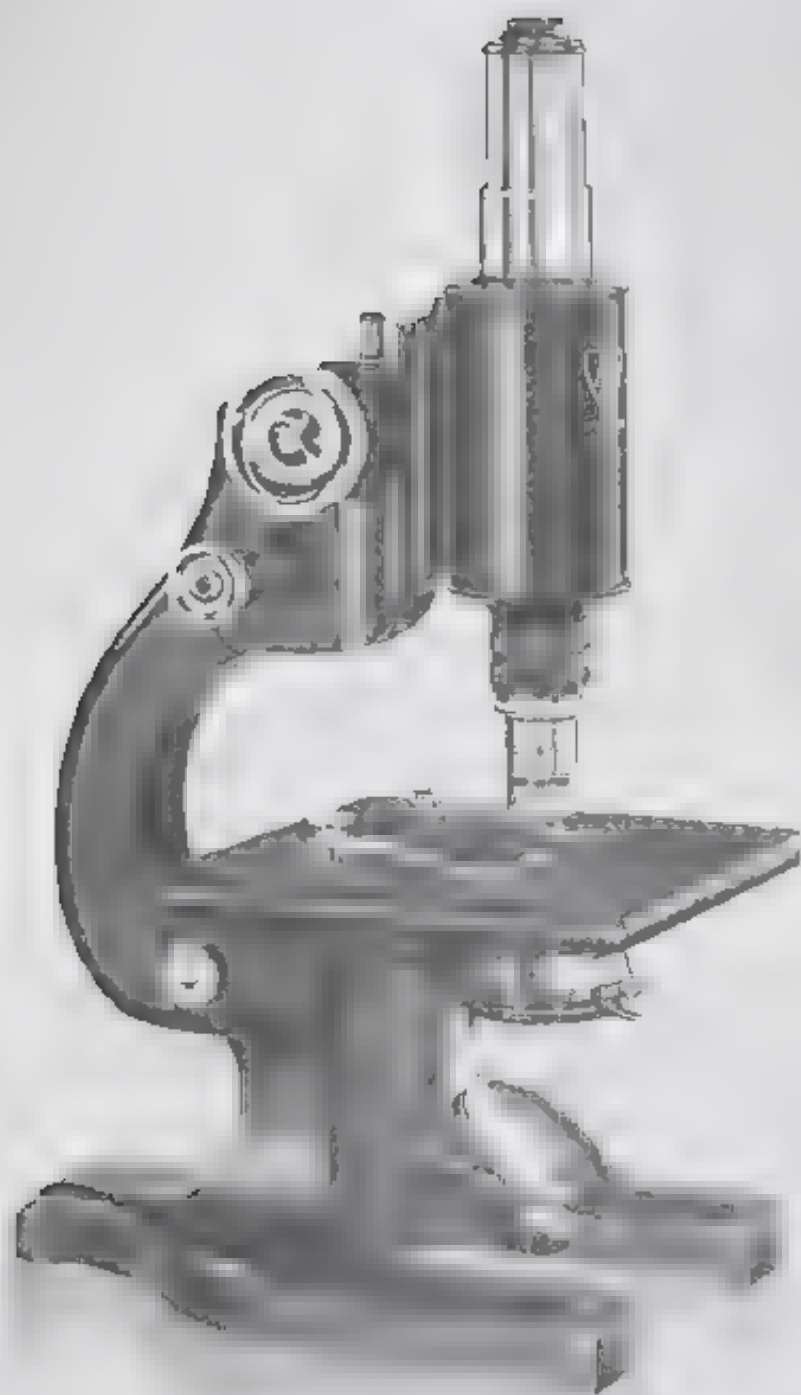


FIG. 1.

# MOLD COUNT MICROSCOPE

Counting No.	Nose- piece	OPTICS		Range of Magnification	Type of Illumination	Special Features
		Field of View (mm.)	Objective			
60	Single	6mm.	10X with 10mm.	100X	Monocular	Slide holder N.A. 0.65
61	Double	6mm. 8mm.	10X with Hewlett-Packard Filter	100X 200X	Monocular	Slide holder N.A. 0.65 Jury Tube
62	Triple	16.4 10mm.	6X 10X with 10mm.	60X to 210X	Monocular	Slide holder N.A. 0.65 Jury Tube
64	Single	16mm.	Paired 10X	60X	Vertical	Back and N.A. 0.65 Jury Tube
65	Single	16.4 8mm. oil	Paired 10X	60X to 210X	Vertical	Back and N.A. 0.65 Jury Tube

No. 417—Hewlett-Packard Chamber, when ordered separately  
No. 307—Glass filter for use below substage condenser as desired



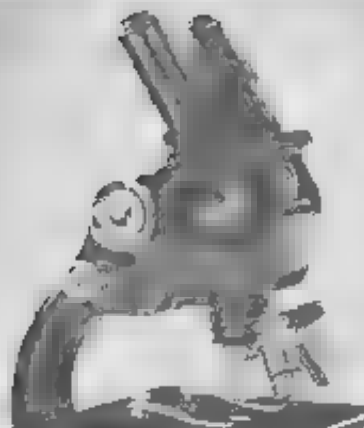


## Bacteria Count Microscope

(Breed and Brew Method)

Preparations are made in advance of making bacteria counts in milk because permanent field sizes are assured. Both binocular and monocular instruments can be calibrated at the factory to provide field diameters of 0.206mm for the 300,000 factor or 0.148mm for the 600,000 factor. Many bacteriologists find it helpful to have the field divided into quadrants to facilitate counting; therefore a special cross hair etched disc is provided and is included with all standard equipment as listed. A condenser, N.A. 1.25, with iris diaphragm is included on all microscopes. Within the limits of the field, as specified above, this microscope can be used for other work.

Monocular microscopes are suitable for this type of work, but binocular instruments are preferred where a great number of tests are involved. In order to calibrate binocular microscopes for counting bacteria in milk, the interpupillary distance of the user must be given.



Binocular Bacteria Count Microscope No. 13 LIT.

Five instruments are listed, two with the oil immersion objective only, three with the complete "H" optics. In laboratories where other microscopic examination is to be made involving lower powers, it is advisable to purchase one of the more complete units.

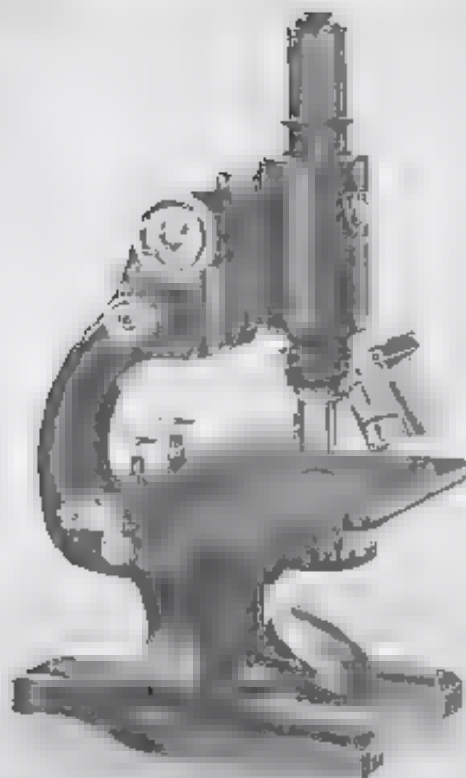
All microscopes are listed with plain square stages. If the large Breed and Brew slide is to be used, a No. 490 Mechanical Stage may be ordered, while for standard sized slides, the built-on Mechanical Stage M may be specified both as an additional

Feature.

Standard Methods for the Examination of Dairy Products, Am. Publ. Health Assoc. N.Y.C. 7th Ed. 1939. 166p.

### BACTERIA COUNT MICROSCOPE

Model	Configuration	Objectives	Field of View	Range of Magnification	Type of Body	Price
3AY	Single	1 8mm oil immersion	6X with No. 427 cross hair	6X to 600X	Monocular with fixed eyepiece. Tilting	
337	Single	1 8mm oil immersion	10X with No. 4 cross hair	10X to 600X	"	
3HYZ	Triple	1 6mm, 4mm, 1.8mm oil immersion	6X and 10X each with No. 427 cross hair	60X to 600X	"	
3HYZ	Triple	1 6mm, 4mm, 1.8mm oil immersion	Pair of 6X and 10X, one of each with cross hair	300,000 and 600,000 bacteria	Vertical Binocular	
3HYZ	Triple	1 6mm, 4mm, 1.8mm oil immersion	Pair of 6X and 10X, one of each with cross hair	300,000 and 600,000 bacteria	"	



Water and Sewage Microscope No. 33M 12

Zeiss Microscope Co., Inc.  
Sewage, American Public Health Association  
C., 5th Edition, 1925, 119 pp.

## Water and Sewage Microscope

For use in the Water Filtration Plant, a standard microscope with magnifications ranging from 60X to 440X will usually prove satisfactory. If the laboratory has occasion to make bacteriologic counts, however, an instrument with an oil im-

For plankton count work the Whipple eyepiece Micrometer Disc No. 416 is supplied in one 10X eyepiece only. For checking calibration of the eyepiece scale, a No. 400 Stage Micrometer is a desirable addition.

A condenser of N. A. 0.66 provides excellent illumination for the lower powers. When the 1.80mm oil immersion lens is ordered, the N. A. 1.25 condenser is necessary.

The same instrument is recommended for the Sewage Treatment Plant laboratory.

For manipulation of slides and for counting, the built-in mechanical stage is a great convenience. It can be removed for the examination of Petri dish cultures.

### WATER AND SEWAGE MICROSCOPE

Catalog	Model	OPTICS		Range of Magnification	Type of	Fork Type Rack and Pinion
		Field of View	Objectives			
33MFR	Double Revolving	18mm 4mm	6X 10X with Whipple	60X 440X	Monocular	With N. A. 0.66 condenser
33MHR	Triple Revolving	6, 4, 1.8mm oil immersion	6X 10X with Whipple Disc	60X to 950X	Monocular Graduated Draw Tube	With N. A. 1.25 condenser and
33MHR	Triple Revolving	6, 4, 1.8mm oil immersion	Same but paired	60X to 950X	Vertical Binocular	With N. A. 1.25 condenser
33MLHR	Triple Revolving	6, 4, 1.8mm oil immersion	Same but paired	60X to 950X	"	"



## Brewmaster's Microscope

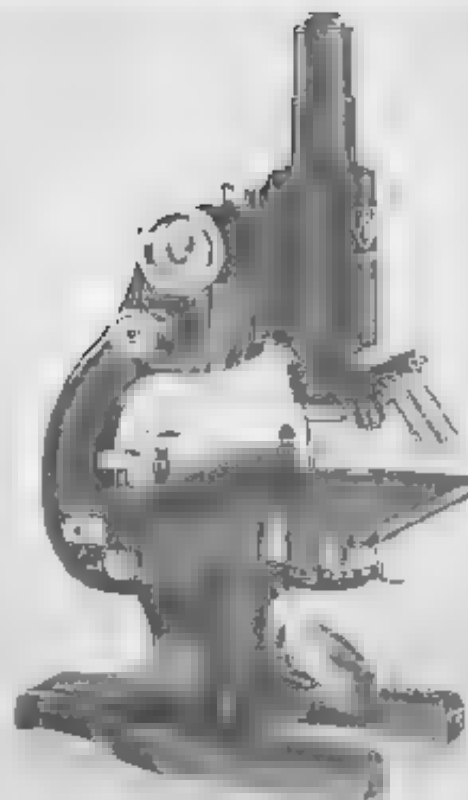
Almost every Brewmaster has accepted the microscope as a requisite in the laboratory. Routine microscopic examination is the only means of assuring continuous and uniform quality production.

A high, dry objective, such as the 3mm N.A. 0.85 has been selected by a number of men in this field because it provides excellent resolution and a magnification of 600X when used with a 10X eyepiece. The working distance of this objective is relatively short, and thin cover glasses must be employed. Consequently this objective cannot be used with a haemocytometer counting chamber.

If a haemocytometer is used for counting yeast, the 4mm N.A. 0.65, which (with 10X eyepiece) provides magnification of 440X, is preferred. Both are listed in the chart below.

An oil immersion lens is often desirable for the examination of bacteria. The more complete equipment is available in monocular and binocular microscopes.

The built-on mechanical stage, a feature of these microscopes, is a convenience in many laboratory work. It can be removed to facilitate the inspection of the contents of Petri dishes or other large specimens.



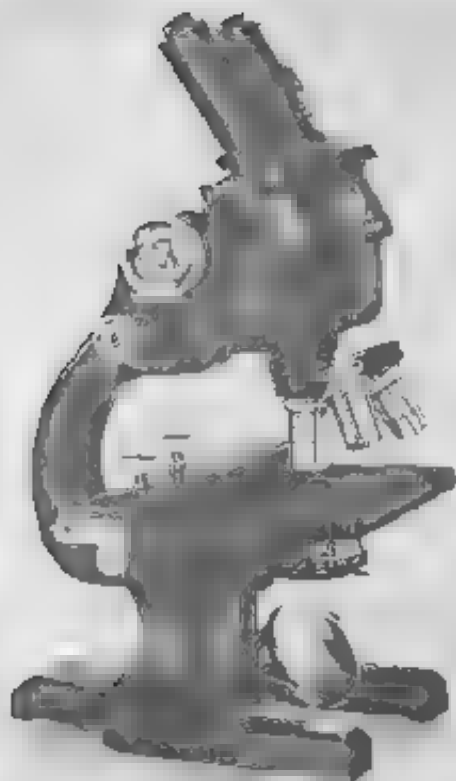
*Spencer Brewmaster's Microscope No. 33MG*

Wood, H. L.—Brewing: Science and Practice, 1935-40, New York, 2 vols.

Tyson, M. A.—The Use of the Microscope, Brewery, *Mos. Brew. Age*, 1941, 23:77-8. 70

### BREWMASTER'S MICROSCOPE

Model	Objective	Throat Objective	Eyepiece	Range of Magnification	Type of Body	Suggested Accessories (not included in price)
33MO	Double Revolving	16mm, 3mm	10X	40X-600X	Binocular	None
33ME	Double Revolving	16mm, 4mm	10X	40X-440X	Binocular	None
33MP	Triple Revolving	16, 3, 5mm oil	6X, 10X	60X-600X	Fixed	None
33MP	Triple Revolving	16, 3, 5mm oil	6X, 10X	60X-600X	Binocular	None
33MTP	Triple Revolving	16, 3, 5mm oil	6X, 10X	60X-600X	Binocular	None



Spencer Textile Microscope No. 13MLT

#### References

1. *Textile Microscopic Methods Used in Identifying Fibers, Cottons, Wool, Silks, and Synthetic Fibers*, by J. H. Mendenhall, Museum Textile Microscopy, 1933, London 117 pp.
2. *Textiles and the Microscope*, by E. R. Schwartz, 1934, New York 199 pp.

## Textile Microscope

Higher standards of quality, demand for uniformity, and rigid government requirements have increased the need for scientific instruments in the textile industry. The microscope is used for:

1. Identification of fibers in blends
2. Determination of quantities of component fibers in blends
3. Determination of defects
4. Determination of extent of saproductification of acetate in blends
5. Detection of impurities and foreign matter
6. Detection of adulteration for inclusions of foreign fibers
7. Counting of bastards in consignment of yarn in yarn
8. Measuring devices indicating percentage of new and used fibers

For this work the microscope recommended is equipped with 10X, 20X, 40X objectives, 6X and 10X eyepieces, a micrometer disk in the eyepiece, a graduated draw tube, a stage micrometer, and N.A. 0.66 substage condenser.

The Spencer No. 385 Substage Lamp is satisfactory for monocular instruments, but the No. 370 Adjustable Laboratory Lamp should be ordered with the binocular.

### TEXTILE MICROSCOPE

Catalog No.	Objective	Eyepiece	Range of Magnification	Type of Body	Substage	Micrometer	Price
13MLT	6mm 10mm 4mm	6X 10X	60X to 440X	Monocular Graduated Draw Tube	Back and Front N.A. 0.66 condenser with iris	+	4.00
13MT	6mm 10mm 4mm	Same but paired	60X to 440X	Vertical Binocular	N.A. 0.66 condenser with iris	+	6.00
13MLT	6mm 10mm 4mm	Same but paired	60X to 440X	Monocular Binocular	Back and Front N.A. 0.66 lenses with iris	+	6.00





## Spencer Research Microscopes

The Spencer Research Microscope has been developed to meet the exacting requirements of the research microscopist, who must spend endless hours searching for minute objects. He necessarily examines specimens thoroughly, usually under the most critical conditions.

They are the culmination of years of experience beginning in the early days of American Microscope Builders with Charles Spencer and Robert Toles, and of cooperation with leading microscopists whose recent publications have affected the

The wide range of optical parts, stages, and substage equipment makes the Spencer Research Microscopes superior. From the lens surfaces, polished to an accuracy of one millionth of an inch, to the flawless satin black and chromium finish, these research instruments exemplify Spencer quality.

The Spencer Research Microscope is a masterpiece of mechanical engineering. The length of light The mechanical adjustments have been refined to give the ultimate in convenience and comfort, and the enduring qualities of Spencer features have been tested by time.





## Equipment of Research Microscopes

Two Research Microscopes are listed with a number of complete optical equipments suitable for advanced visual work and photomicrography. Several stages and substage equipments are available. Monocular, vertical binocular, or inclined binocular bodies may be specified.

Interchangeability of parts permits a wide range of choice which the advanced worker appreciates. The different parts are described and priced separately so that it is possible to calculate the price of a microscope when a substitution or addition of parts is desired.

### Stands

The research stands are designed to achieve rigidity, stability, and graceful symmetry. The inclination joints permit smooth adjustment to any inclined angle, while the well-proportioned bases insure stability in all positions. The arms are carefully made to reduce bulk to a minimum and yet preserve proper rigidity.

The black finish is a handsome velvet enamel. The bright parts are finished in chromium. All instruments are tested with a triple or quadruple nosepiece, according to the number of objectives specified.

All Spencer Research Microscopes are carefully assembled and inspected before leaving the factory. They are sent out in polished or leatherette covered hardwood cabinets with compartments for accompanying accessories.

### Fine Adjustment

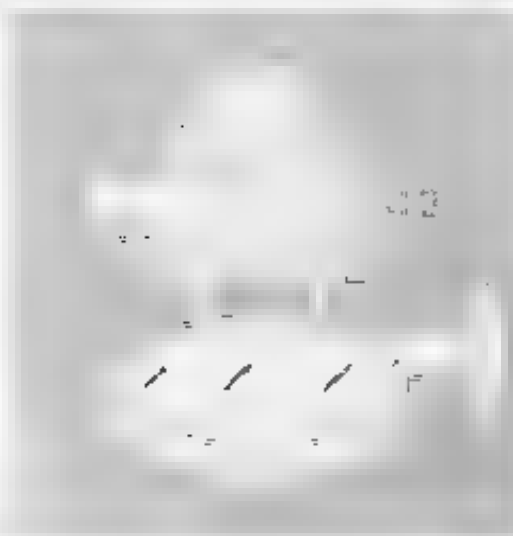
A noteworthy and important feature on Spencer Research Microscopes is the low-positioned fine adjustment. The hand rests comfortably on the table while operating the fine adjustment buttons, mechanism, stage, or substage.

The fine adjustment is the all-important mechanical element in the microscope stand. In Spencer microscopes the important constituent in this part is a micrometer screw and nut, built and fitted with the precision and accuracy of a measuring instrument. The large bearing surface between thread and nut assures permanency as well as accuracy.

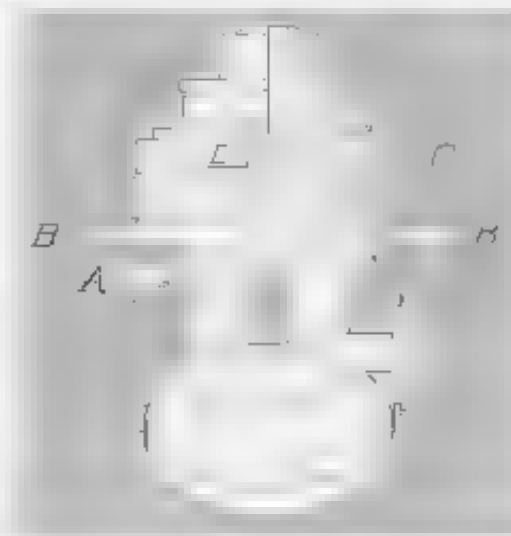
A rigid connection in the arm leads from the micrometer screw at the base of the arm to the fine adjustment bearing at the top. There is a small knurled button on the top of the arm for regulating the tension in the fine adjustment. The metals used in the fine adjustment bearings have been carefully selected to avoid friction, and oil grooves have been incorporated to provide constant lubrication. These parts, together with the heavy bearings and the bell crank lever, make a fine adjustment providing accuracy, responsiveness, and durability.

The fine adjustment buttons actuate the up-and-down movement of the binocular body or the single body tube, together with the nosepiece. This avoids the objectionable variation in tube length which occurs if only the nosepiece is moved.

*Simple Substage with N.A. 1.25 condenser*



*Complete Research Substage with achromatic condenser*



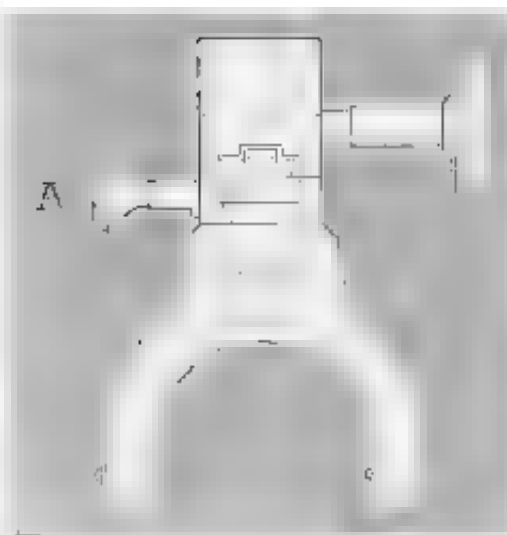


## Substages

The Spencer fork type substages are unique, assuring permanent and proper relationship between the optics and the mechanical parts. Anyone accustomed to the old-style friction ring on a substage appreciates the ease with which the condenser unit may be removed and replaced, and the accuracy to which the unit is held in the optical axis. Two spring plungers strap the unit firmly into place against the back surface of the fork-type support, preventing any slippage. All substages are actuated by diagonal rack and pinion for focusing the condenser.

The simple substage supplied on the No. 3 Microscope consists of the focusing means and the fork just described, the fork becoming the support for the condenser mounting and its diaphragm. The condenser mount No. 324 is graduated to indicate the numerical aperture permitted by the iris diaphragm. A centering mount for the condenser may be substituted at an increase in cost. A centering mount can be provided for all condensers, but the No. 322 should certainly be specified when the achromatic condenser is selected or supplied. The Spencer combined oblique light and centering mount can also be supplied for all condensers, and may be obtained at an increased cost to make a complete substage. The No. 333 auxiliary condenser is a useful accessory to add to the substage when low power objectives are used.

The complete research substage is supplied on the No. 5 stand. The fork-type support in this substage is focused by the diagonal rack and pinion, and also by a fine adjustment (A) similar to that used for focusing the objectives. When high grade condensers, or objectives used as condensers, are used for critical work, this fine adjustment feature is very important. The research substage is completely equipped and consists of the following parts: The condenser mount has the centering mechanism (B), iris diaphragm (C), and oblique lighting feature (D). There are also adapters, by means of which one may use an objective as a condenser, and an auxiliary condenser, which may be supplied and used in place of the condenser mounted on a low power objective.



Fork-type Rack and Pinion Substage Mounting as used on No. 5 fine adjustment head (A) shown open.

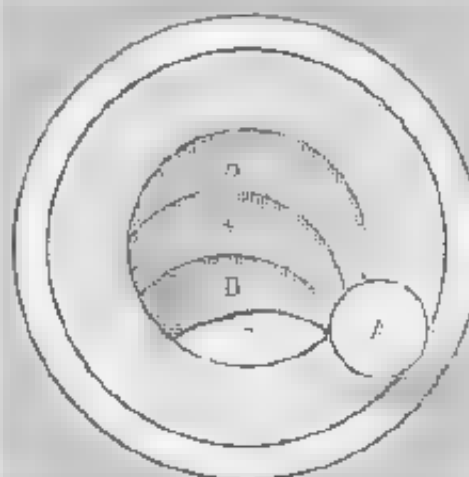
## Centering

The centering mechanism of the condenser and iris is substantial. Heavy screws are provided so that the condenser is brought into alignment.

## Oblique Light

Oblique light is obtained by a new design of iris diaphragm. It is independent of the condenser and consists of three leaves pivoted on a common axis at one end of each leaf, by turning a button (A), these leaves close the aperture from one side only, leaving an opening (C) for the decentered light to strike the condenser. For the same amount of obliquity, the volume of light is three times that admitted when the iris is decentered. The obliquity can be obtained from the desired amount by revolving the ring, to which the leaves are attached, around the optical axis. For simplicity and effectiveness it is without an equal.

Oblique Light Feature





*Vertical Binocular Body.*

## Microscope Bodies

All Spencer Research Microscopes are priced with two bodies as a standard, with an additional body available for the binocular model. The Spencer Research Microscope, whether binocular or monocular, may be used interchangeably.

### Monocular Body

The monocular body is regularly supplied, as 50mm. in diameter and 500mm. in height, with a removable draw tube at the upper end with a removable draw tube for varying the tube length. It is constructed of special alloy steel.

The draw tube may be removed to give a very low magnification for photomicrography. The draw tube is graduated in inches and centimeters, and is fitted with a special mark and a special mark on the inner tube. The draw tube is fitted with a special mark and a special mark on the inner tube. The draw tube is fitted with a special mark and a special mark on the inner tube.

The draw tube of this monocular body is fitted with a special mark and a special mark on the inner tube. The draw tube is fitted with a special mark and a special mark on the inner tube. The draw tube is fitted with a special mark and a special mark on the inner tube.

The graduated draw tubes are fitted in special cloth-lined sleeves and work very smoothly.

*Horizontal Binocular Body with Converging Eyepieces.*

*Path of light through Inclined Binocular Body.*





## Binocular Bodies

On the Spenger binocular bodies, the eyepiece tubes converge at an included angle of  $8^{\circ}$ , which is a very comfortable angle of convergence for the eyes. One looks into the two eyepieces in the natural easy way and finds the two images without the slightest difficulty. When picking up a slide and placing it on the stage of the microscope, the eyes converge in the natural manner. The same angle of convergence is maintained when looking into the microscope. Binocular fusion is easy, natural and comfortable.

Paired eyepieces can be supplied on the L body at no extra charge if specified or requested.

A knurled ring at the base of one of the eyepiece tubes provides for adjustment for various interpupillary distances. The graduated scale on this ring indicates the interpupillary separation.

On the other tube is a knurled ring to lengthen or shorten the tube to compensate for differences in the accommodation of the two eyes.

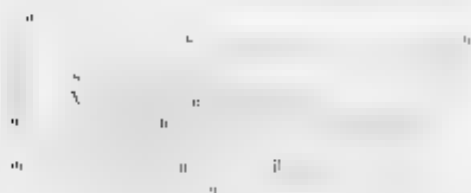
### Standard Binocular Body B

On the standard binocular body B the eyepiece tubes are in a vertical position.

### Inclined Binocular Body L

The inclined binocular body L is like the B described above, except that the eyepiece tubes are inclined at an angle of

$10^{\circ}$  toward the operator. The difference between the two bodies is shown in the following diagram.



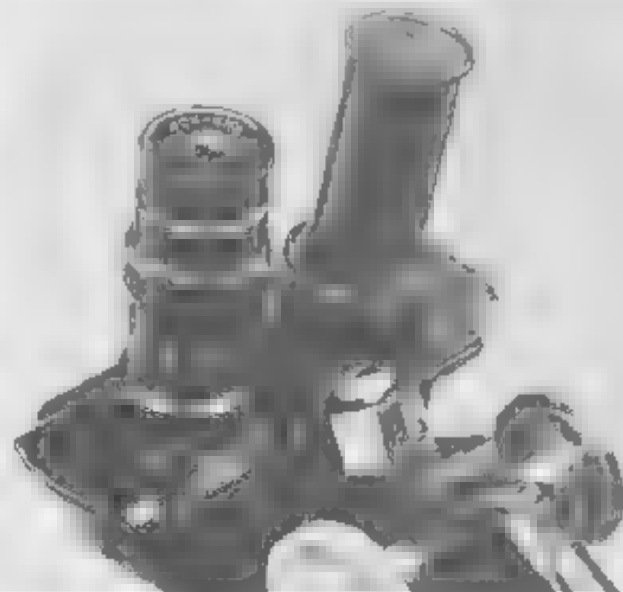
Graduation indicates interpupillary distance and



Standard Body with Graduated Wheel



Inclined Binocular Body with Paired Eyepieces





## Stages Applicable to Microscopes Nos. 3 & 5

A large stage is a necessary feature on any microscope. The stage must also be fastened rigidly to the microscope so that there is no movement to change the focus when the hand rests on it. The stage should be made of a material that will not scratch or be scratched when in contact with the ordinary laboratory reagents. All these conditions are met in Spencer stages.

### Plain Square Stage S.

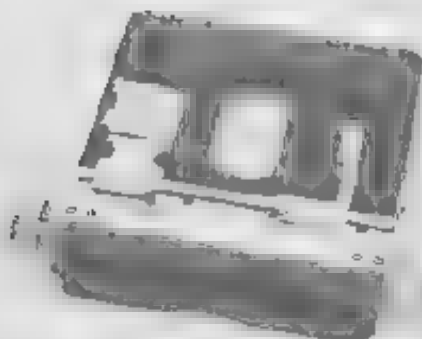
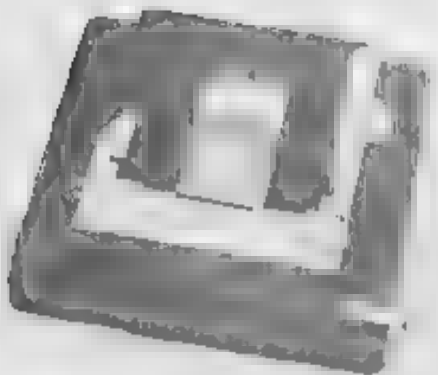
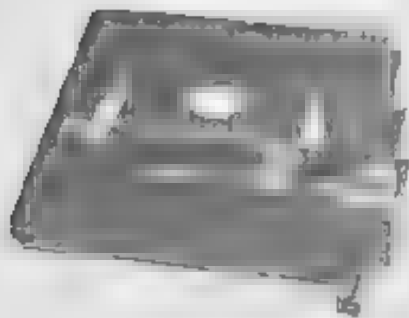
The Plain Square S stage No. 482 is cast from a hard, rigid, durable Bakelite. It is 75mm square. Many thousands of Spencer Medical Microscopes, equipped with S or M Stages, are now in daily use.

### Combination Plain and Mechanical Stage M.

The Rectangular M Stage No. 483, a plain stage with a mechanical stage permanently fastened to the edge, has made a very practical, popular, and inexpensive combination. Buttons on vertical axes operate the diagonal rack and pinion movement in both directions. The to-and-fro excursion is 50mm and the lateral excursion is 75mm. When a plain stage is desired, the part above the surface of the stage may be removed by sliding it off its side bearings. The side clip on the right is permanently locked, while the one on the left is kept in contact with the slide by springs on the top. This is a very sturdy stage holding slides up to 50mm x 75mm.

### Combination Plain and Mechanical Stage P.

The Combination Plain and Mechanical P Stage (125mm square) are operated by buttons on horizontal axes. These are fastened to the stage by screws, and move readily to 0.1mm. This 125mm square stage is 50mm x 75mm. The P Stage No. 1520 is fitted with simple slide clips and







buttons on the right side only in a catalogued equipment. The right hand slide clips adjustable in a groove to accommodate slides of different lengths. The left slide clip is also adjustable in the same groove and is held against the end of the slide by the tension of a spring. However, this stage can be supplied with operating buttons on both sides and special slide clips at an increased price, with these additions it is classified as No. 1323 in the price list.

### Combination Plain and Mechanical Stage R

The Combination Plain and Mechanical R Stage is 115mm square. It is listed as No. 493 for use on the No. 5 Microscope and as No. 494 for use on the No. 3. The mechanical movements are motivated by concentric buttons on horizontal axes. The range of movement is 40mm x 75mm with graduations and verniers reading to 0.1mm. The stage is fitted with operating buttons on both sides, and with the special Spencer slide clips. The slide clips may be removed from the stage and a large flat plate substituted on which Petri dishes and other stage objects may be placed. When used in this manner it can be rotated by the mechanical adjustments in both directions.

### Circular Revolving Mechanical Stage V

The Circular Revolving Mechanical V Stage No. 1531 is 150mm in diameter and is made of vulcanized rubber on a bronze foundation. Centering screws are provided to bring the center of rotation in alignment with the optical axis of the microscope. It may be locked so that it will not revolve.

The bearing for the to-and-fro movement is in a groove on the surface of the stage. The parts on this groove all remain below the upper surface of the stage, a slide easily passes over them. The buttons operating

the two movements are on concentric axes. The to-and-fro movement is 50mm and the lateral movement is 75mm, with verniers reading to 0.1mm. All the movable parts of the stage are easily removed, and a plate is provided to cover the groove, thus converting it to a plain circular stage. The periphery of the stage is graduated, and, with a vernier, reads to three minutes of arc. Special Spencer slide clips are provided.

### Circular Revolving Mechanical Stage W

The Circular Revolving Mechanical W Stage No. 1532 is 150mm in diameter. It is provided with centering screws and means for locking it so that it cannot revolve. The buttons for manipulating the stage are on horizontal axes, placed far enough away from other parts to permit easy operation. In other respects, this stage is identical to Stage P, but it is mounted on a circular revolving stage. Buttons are on the right side only and simple slide clips are supplied as standard equipment.

### Circular Revolving Mechanical Stage X

The Circular Revolving Mechanical X Stage No. 1540 is similar to Stage W, but is heavier and has additional features that add to its convenience. The operating buttons on both sides remain at the same distance from each other and from the optical axis. One becomes accustomed to their fixed position and automatically reaches to the right place for them. The stage has a graduated periphery with a vernier reading to three minutes of arc. When the slide clamps are removed they may be replaced by a large plain stage, which may be used like any plain stage. It may also be actuated by both of the mechanical movements. Special Spencer slide clips are provided.

V Stage

W Stage

X Stage





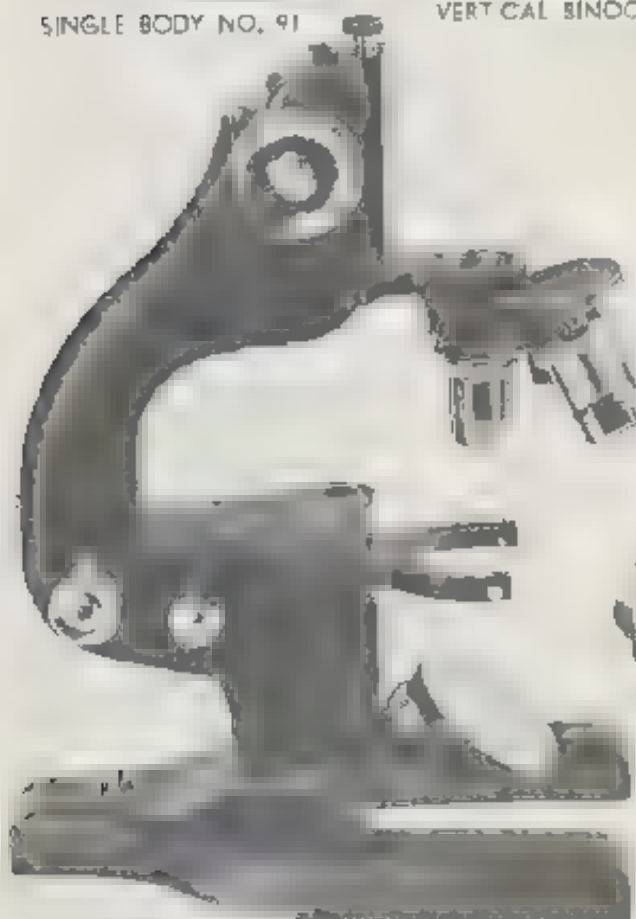
SINGLE BODY NO. 91



VERTICAL BINOCULAR BODY B



INCLINED BINOCULAR BODY L



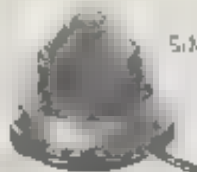
2. EARL H. MCR, COPE STAND 100



CIRCULAR REVOLVING MECHANICAL STAGE W



PLAIN AND MECHANICAL STAGE P Bythane both sides,



SIMPLE SUBSTAGE MOUNTING



COMPLETE SUBSTAGE MOUNTING



## Selecting A Research Microscope

Aside from the stands of the Research Microscopes, there are three standard parts, each made in a diversity of forms and offering a broad selection to suit specific needs, or special tastes. We refer to the different styles of body tubes, the large number of stages (plain and combination plain and mechanical), and the choice of different constructions in the substage. The interchangeability of these parts permits a range of choice which the discriminating worker appreciates. The different parts are described and priced separately so that it is possible to calculate the price of a microscope when a substitution or addition of parts is desired.

Each part is designated by its own particular letter and catalog number. The number of each microscope is a combination of the letters of the parts involved. For instance, No. 3LPH Microscope is composed of No. 3 Stand, L Body Tube, P Mechanical Stage, and the H Optical

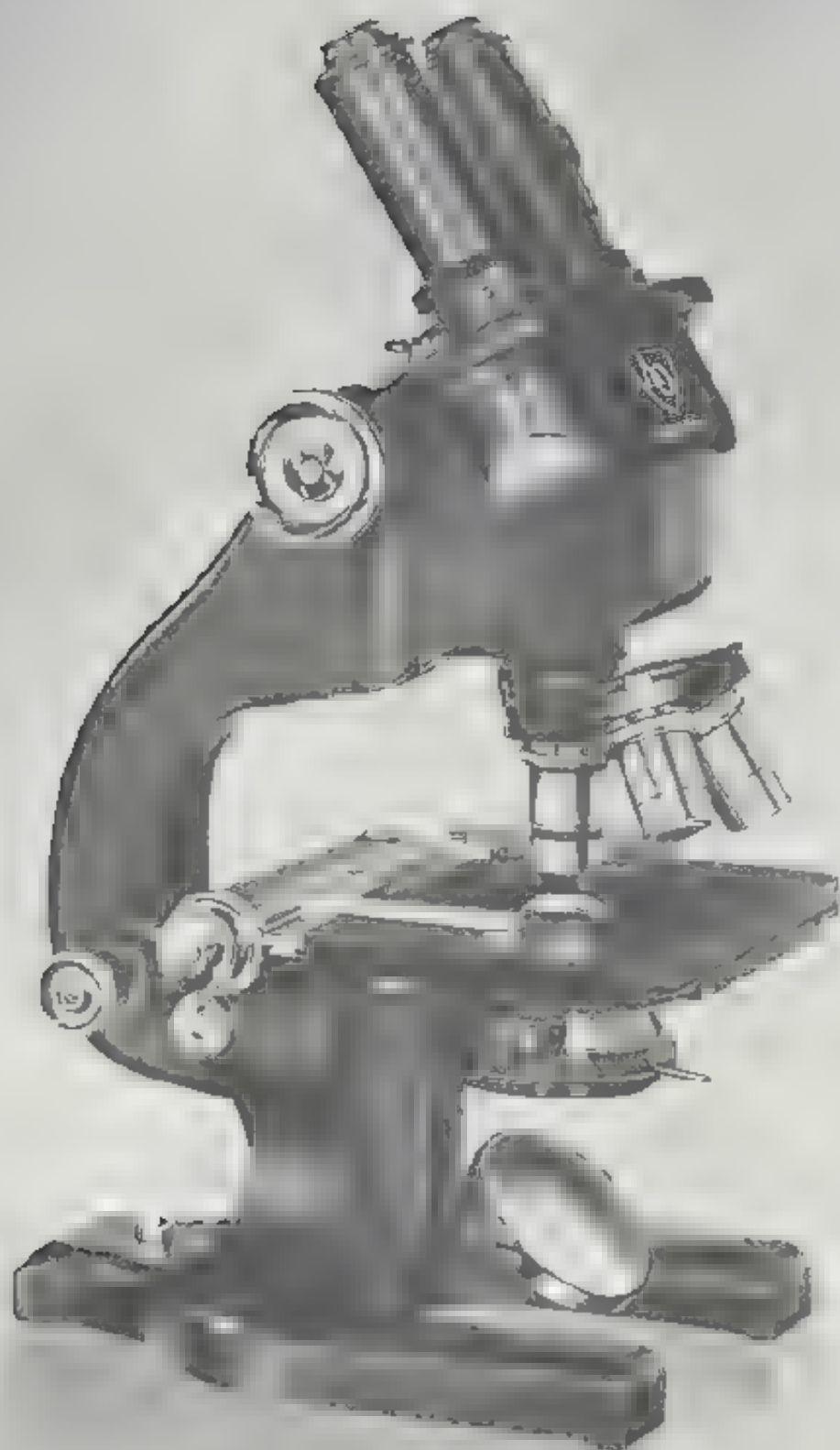
In every instance the number beside a revolving nosepiece signifies the number of objectives specified.

On microscopes calling for the 4mm achromatic objective, the N.A. 0.06 objective will be furnished, but on Microscope No. 3 the N.A. 0.85 objective is supplied. When specifically requested, the N.A. 0.85 will be furnished on any microscope at the same price. In microscopes calling for the 2mm apochromatic objective, the objective having a numerical aperture of 1.30 will be furnished. If the N.A. 1.40 objective is desired, it may be purchased at the indicated price. An achromatic condenser N.A. 1.30 is standard with all apochromatic equipments on the No. 3 Microscope, and with all equipments on No. 5 Microscope. The Abbe condenser N.A. 1.25 is standard with all achromatic and fluorite equipments on No. 3 Microscope.

The combinations listed above do not represent the complete line of objectives and eyepieces, but are suggested because they are those most often selected for research work. Substitutions and additions may be made to suit the purchaser. By referring to the prices of objectives, eyepieces, condensers, etc., one may arrive at the cost of any optical combination desired.

## Optical Outfits

STAND	BODY TUBE	STAGE	OBJECTIVES		EYEPiece POWERS		CONDENSER
			Rev.	Imm.	Rev.	Imm.	
H	16-4mm	1	1	1	5X-10X	1	Abbe N.A. 1.25
H	16-4mm	1	1	1	5X-10X	1	Abbe N.A. 1.25
H	16-4mm	1	1	1	5X-10X	1	Abbe N.A. 1.25
H	16-4mm	1	1	1	5X-10X	1	Abbe N.A. 1.25





## Spencer No. 3 Research Microscope

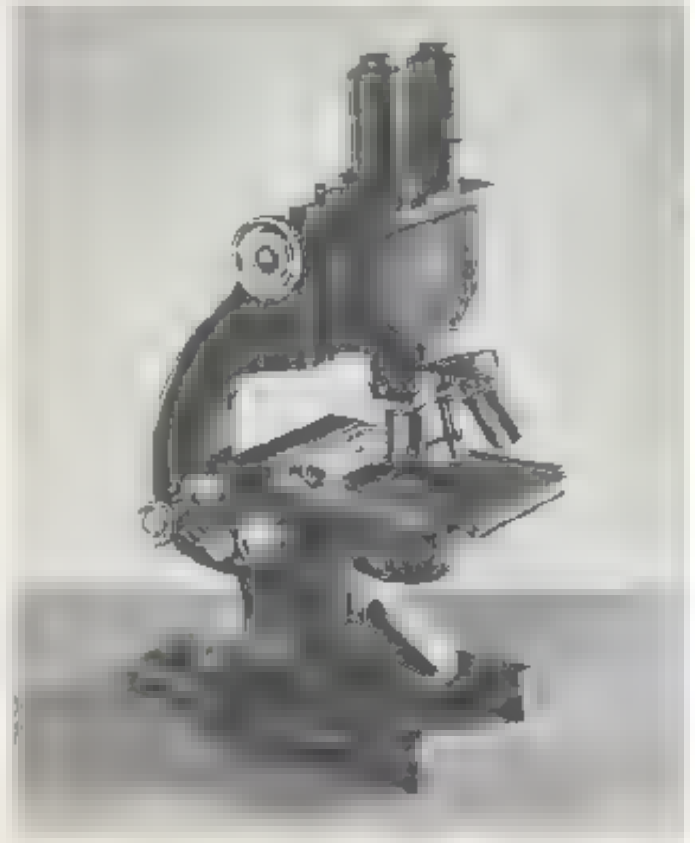
The Spencer No. 3 Research Microscope is larger than the Advanced Laboratory and Medical Microscopes, but smaller than the No. 5. It has the low line adjustment so that the worker's hands remain in close proximity to the other working parts. A rigid connection in the arm leads from the micrometer screw at the base of the arm to the fine adjustment bearing at the top. There is a small knurled button on the top of the arm for regulating the tension in the fine adjustment.

### STAND

The stand has a cast brass arm with a standard taper male inclination joint and a heavy cast iron base that insures stability in all positions.

### RACK AND PINION COARSE ADJUSTMENT

The rack and pinion coarse adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop which is provided prevents breaking the cover glass when focusing with the 16mm. objective.



← Left, Spencer Research Microscope No. 3, R.H.



#### MICROMETER SCREW TYPE FINE ADJUSTMENT

The fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass. It is graduated in 2.5 micron intervals.

#### FLAT-CONE NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective provided, unless otherwise specified,

#### CONDENSER AND SUBSTAGE

An Abbe N.A. 1.25 condenser in the simple substage mount with iris diaphragm No. 324, is supplied when achromatic and fluorite objectives are specified, but when apochromats are used, the achromatic condenser (N.A. 1.30 or 1.40) is supplied in simple substage mount.

No. 324. It is recommended, but the preferable mount No. 322 be selected in all cases where the achromatic condenser is supplied. The oblique lighting feature is useful occasionally where difficult resolution is involved. Auxiliary condenser No. 333 is available to slide into the substage when low power objectives are used.

#### MIRROR

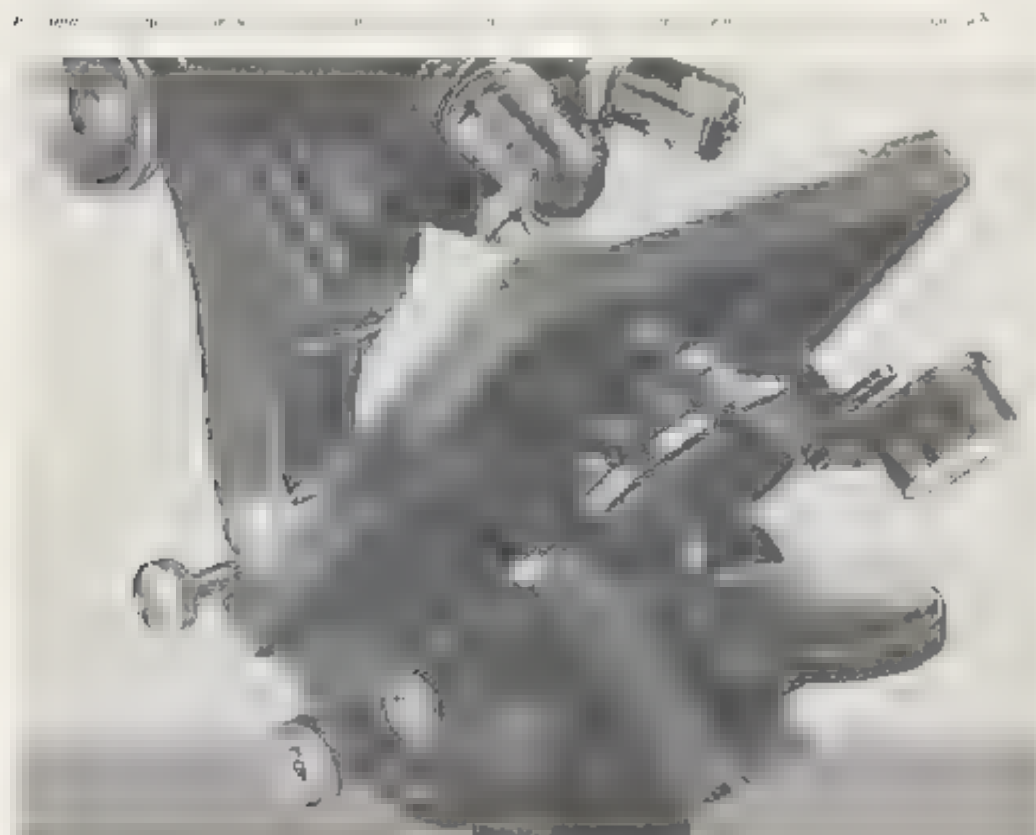
The standard diameter mirror, mounted in a fork for tilting to any desired angle, is concave on one side and plane on the other. It may be removed for cleaning.

#### FINISH

The finish is black baked enamel and chromium plating.

#### CABINET

A leatherette covered hardwood cabinet, with a drawer for accessories, a lock, and plastic boxes for objectives.







## No. 3 Research Microscope Suggested Outfits

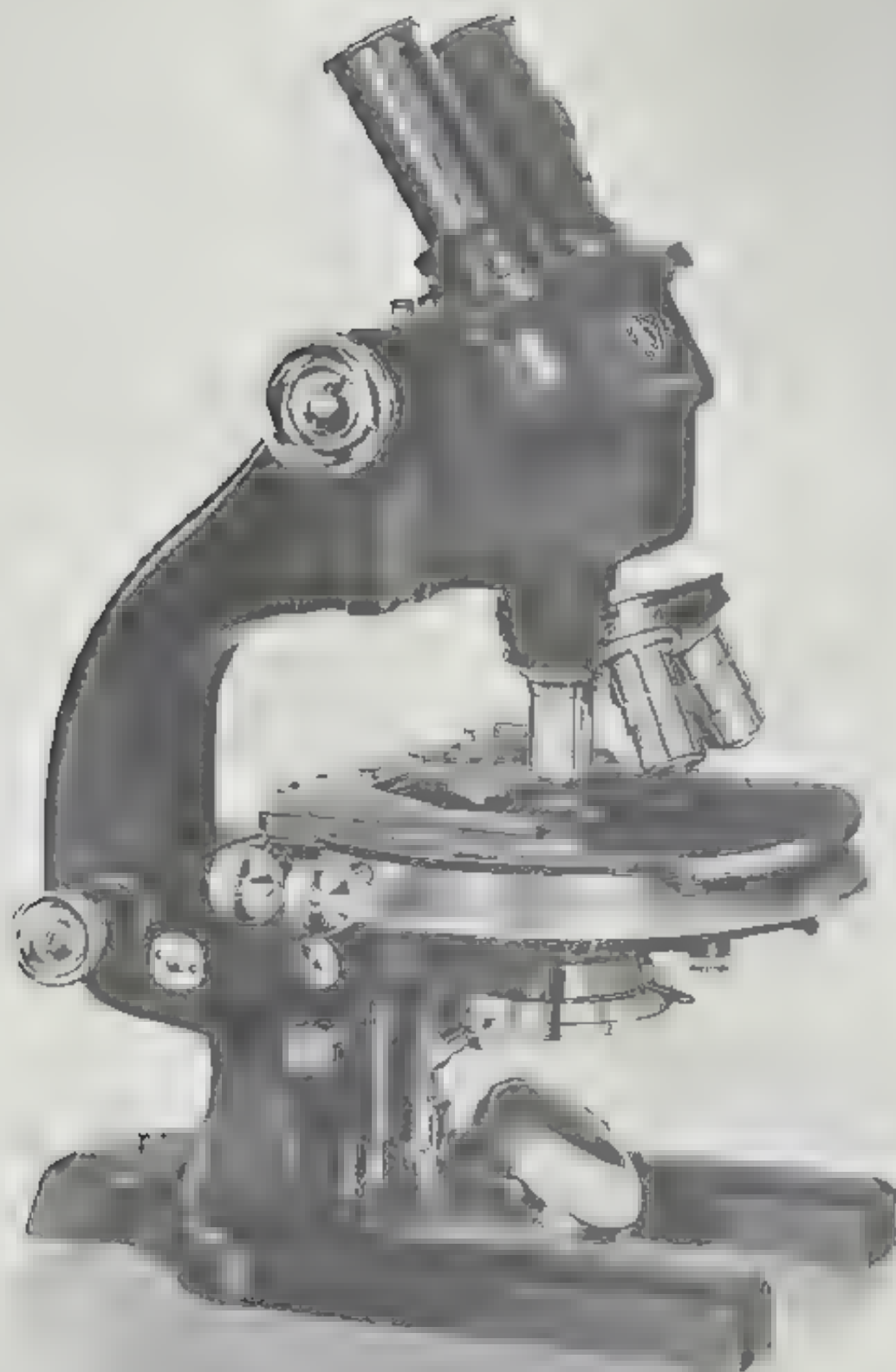
Cat. No.	Body Tube	Stages	Optical Outfits	
3			"H" OPTICS	
4		A	6X-10X	5X-10X
5	4	P	6X-10X	5X-10X
6		C	6X-10X	5X-10X
			2mm. N. A. 1.25	6X-10X
			10X-100X	
7		A		
8		S	5X-10X	
9		M	6X-10X	5X-10X
10		P	6X-10X	5X-10X
11		R	6X-10X	5X-10X
		V	2mm. N. A. 1.30	5X-10X
		W	10X-100X	
12		V		
13		S	5X-10X	
14		M	6X-10X	5X-10X
15		P	6X-10X	5X-10X
16		P	6X-10X	5X-10X
17		V	2mm. N. A. 1.30	5X-10X
18		W	10X-100X	
19		V		

Prices for above standard catalog outfits will be found in the price supplement to this catalog. The above outfits are suggested for the following purposes: (1) For general use, (2) For use with the "H" objectives in the outfit, simple substage, non-centerable condenser, and 2mm. N. A. 1.30 achromatic N. A. 1.30 condenser with all apochromatic objective outfits, monocular body tube with adjustable draw tube in addition to binocular body—all complete in a catheterette covered hardwood cabinet with drawer for accessories.

When equipments are selected with achromatic condensers, it is recommended that the centerable mount No. 322 be selected.

If desired, an N. A. 1.40 achromatic condenser may be substituted for the N. A. 1.30 condenser at no change in price.

A complete list of accessories and their prices will be found in the price supplement to this catalog. The above outfits are suggested for the following purposes: (1) For general use, (2) For use with the "H" objectives in the outfit, simple substage, non-centerable condenser, and 2mm. N. A. 1.30 achromatic N. A. 1.30 condenser with all apochromatic objective outfits, monocular body tube with adjustable draw tube in addition to binocular body—all complete in a catheterette covered hardwood cabinet with drawer for accessories.





## Spencer No. 5 Research Microscope

The Spencer No. 5 Research Microscope, larger and heavier than the No. 3 or Medical and Laboratory Microscopes, is designed for the most critical research work. Both the base and the arm are larger than the No. 3. It has the low fine adjustment so that the worker's hands remain in close proximity to the other working parts. A rigid connection of the arm leads from the micrometer screw at the base of the arm to the fine adjustment bearing at the top. There is a small knurled button on the top of the arm for regulating the tension in the fine adjustment.

In addition to overall size, No. 5 differs from No. 3 in the following respects:

1. A different leverage in the fine adjustment mechanism gives a graduation value of one micron.
2. The substage fork is controlled by a fine adjustment as well as a coarse adjustment.
3. The complete substage has centering screws and an opaque light control.
4. A mounted auxiliary lens, to raise the focal point for hanging drop work or low power objectives, slides into the substage slot.

5. A mount is included for holding an objective in place of the substage condenser for certain types of work.

6. The mirror is mounted on a slide so that its distance below the substage may be controlled.

### STAND

The stand has a cast brass arm with a standard taper axis inclination joint and a heavy cast iron base that insures stability in all positions.

### RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design. A mechanical stop which is provided prevents breaking the cover glass when focusing with the 16mm. objective.

### MICRO-ALTER SCREW TYPE FINE ADJUSTMENT

The fine adjustment automatically compensates for wear and ceases to function when the objective contacts the cover glass. It is graduated in 100 divisions of one micron.



*Assembling substage condenser for No. 5 with blue glass and ground glass.*



FIG. 1. NOSEPIECE ASSEMBLY

#### DIAPHRAGM NOSEPIECE

The exceptionally large bearing surface provided by the opposing conical bearings maintains the accurate alignment of objectives and automatically compensates for wear. The nosepiece has an opening for each objective unless otherwise specified.

#### CONDENSER AND SLIDESTAGE

An automatic condenser is supplied with the complete research substage. The numerical aperture will be 1.30 or 1.40 depending on the numerical aperture of the objectives selected.

The condenser is designed to raise the focal point of the objective properly the entire field of a low power objective. The centering mechanism is provided with heavy screws, so that the condenser can be adjusted to a perfect alignment with the rest of the optical system. The oblique light feature is independent of the iris diaphragm and

resolution is involved. A fine adjustment for the condenser, operating in the same manner as does the fine adjustment on the arm, is very important for all real work.



#### MIRROR

The standard diameter mirror, in a frame for fitting to any desired angle and on a sliding mount, is concave on one side and plane on the other. It may be removed for cleaning.

#### FINISH

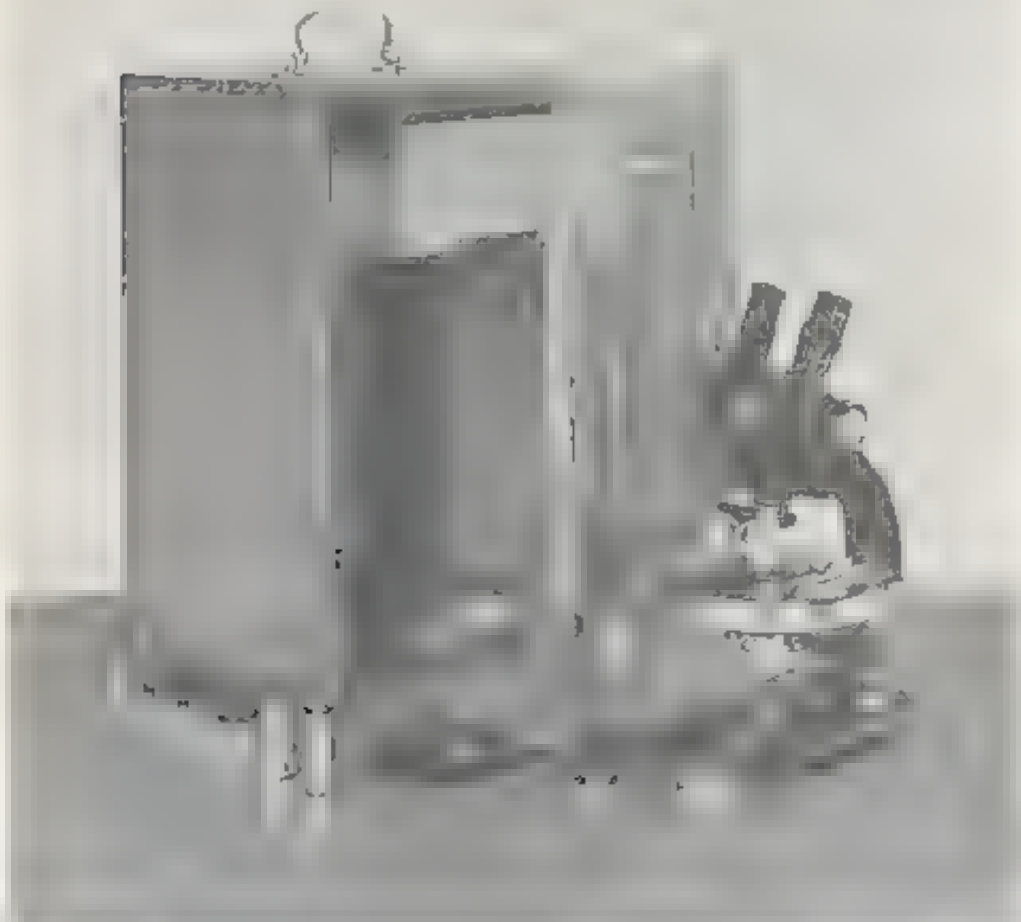
The finish is black baked enamel and chromium plate.

#### CABINET

A polished hard wood cabinet with a drawer for accessories, a lock, and six lock boxes for objectives is provided.

*Spencer Research Microscope No. 52 RH*

*or, with drawer for accessories, standard equipment with No. 5 Research Microscope*





## No. 5 Research Microscope Suggested Outfits

Cat. No.	Body Tube	Stages	Optical Outfit		
H OPTICS					
5LPH	L	P			
5LRH	L	R	Objectives	Eye pieces	Condenser
5LVH	L	V	Achromatic	Huyghenian	Achromatic
5LWH	L	W	16-4mm	Paired	N.A. 1.30
5LXH	L	X	16mm N.A. 1.25 of 4mm	5X-10X	
G OPTICS					
5LGH	L	P			
5LRG	L	R	Objectives	Eye pieces	Condenser
5LVG	L	V	Apochromatic	Compensating	Achromatic
5LWG	L	W	16-4mm	Paired	N.A. 1.30
5LXG	L	X	2mm N.A. 1.30 of 10mm	5X-10X	
K OPTICS					
5LKH	L	P			
5LRK	L	R	Objectives	Eye pieces	Condenser
5LVK	L	V	Apochromatic	Compensating	Achromatic
5LWK	L	W	16-8-4mm	Paired 5X	N.A. 1.30
5LXK	L	X	2mm N.A. 1.30 of 10mm	10X-5X-20X	

The stages listed above are described on preceding pages.

Prices for above standard catalog outfits will be found in the price supplement to this catalog. Look for the complete catalog number, for example, 5LRH or 5LXK. The prices include the following: complete research substage with fine adjustment, centerable condenser mount, iris diaphragm, oblique light unit, achromatic N.A. 1.30 condenser, auxiliary condenser, ground glass and blue glass filters, monocular body tube with adapter for binocular use, and a 4mm N.A. 0.85 achromatic objective.

If desired an N.A. 1.40 achromatic condenser may be substituted for the N.A. 1.30 at no change in price.

A vertical binocular body tube may be selected instead of the inclined type at the price indicated in the price supplement. In this case the letter "L" in the catalog number is omitted and the letter "B" substituted, viz., 5BRH.

The 4mm N.A. 0.85 achromatic objective is supplied on the No. 5 Microscope when ordered for use with the inclined body tube. This objective is designed for use under high dry magnification. If, however, it is intended that blood count work will be done, it is essential that a 4mm N.A. 0.66 objective be specified in order to fix us through the cover glass on a hemacytometer.



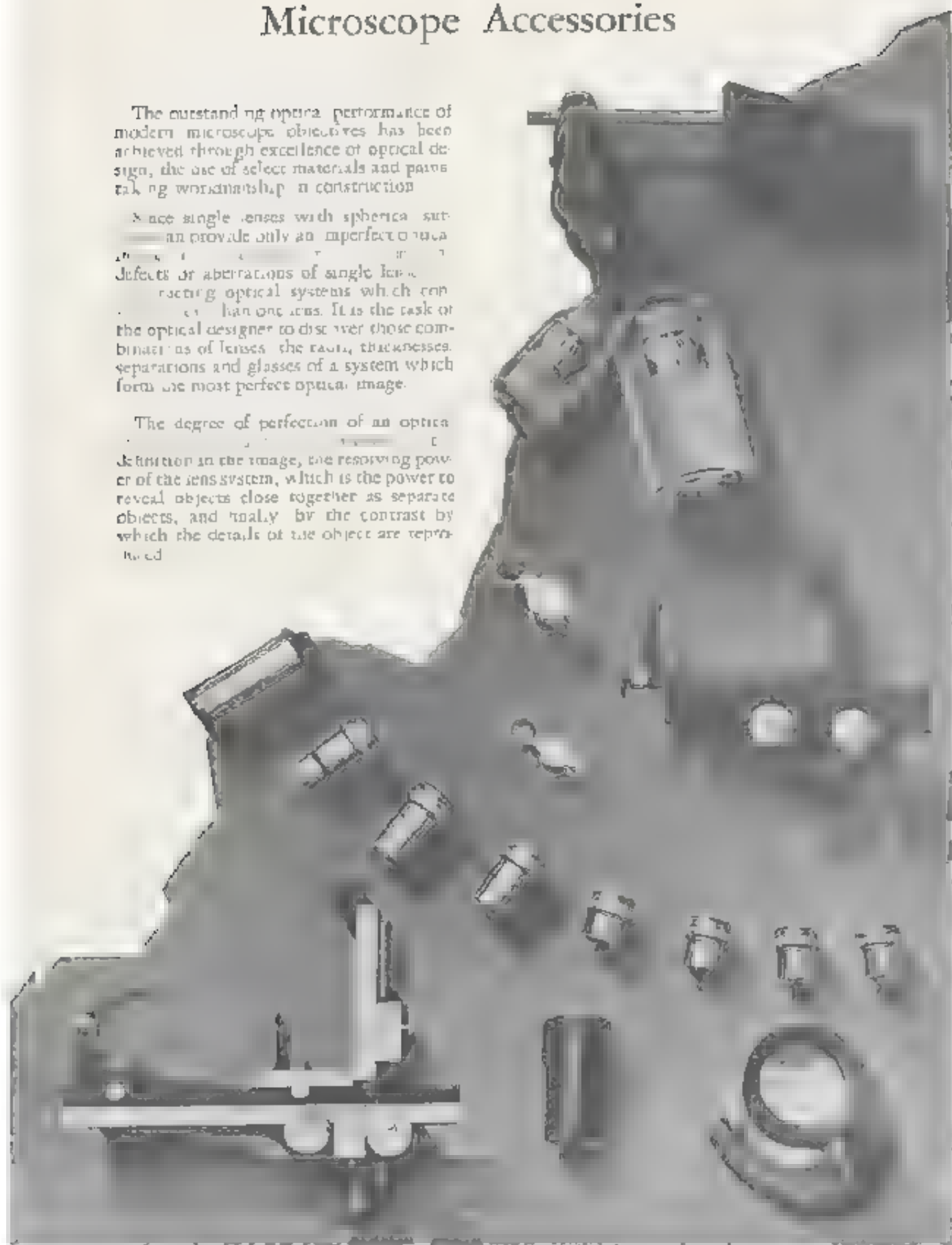
## Microscope Accessories

The outstanding optical performance of modern microscope objectives has been achieved through excellence of optical design, the use of select materials and painstaking workmanship in construction.

Since single lenses with spherical surfaces provide only an imperfect optical

image, defects or aberrations of single lenses are corrected by combining them into compound optical systems which consist of more than one lens. It is the task of the optical designer to discover those combinations of lenses, the radii, thicknesses, separations and glasses of a system which form the most perfect optical image.

The degree of perfection of an optical system is measured by its resolution, the definition in the image, the resolving power of the lens system, which is the power to reveal objects close together as separate objects, and finally by the contrast by which the details of the object are reproduced.







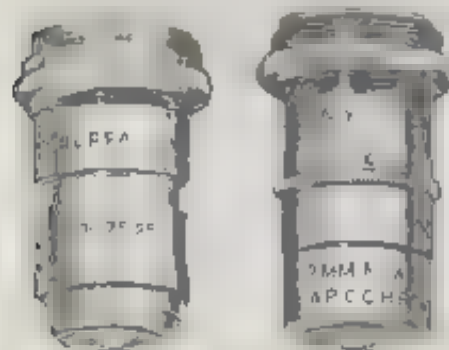
## Spencer Optics

The definition of the lens system depends primarily on its image-forming qualities. Its objectivity is realized if all the rays from a point on the object are refracted to one and the same point in the image, and if this is true for all other points in the object. Further more, the condition should be satisfied for rays of different color, which is called correction for chromatic aberration. By a careful mathematical analysis of the refractive action of lenses on the light rays, it is possible to select lens combinations in which this idea is very nearly reached. The methods of the optical designer to solve this difficult mathematical problem form a special and extended field in the science of optics, the so-called Geometrical or Ray Optics. Many outstanding physicists and mathematicians try all countries have felt the challenge of the optical design problem and have given consideration to its successful solution. Since the days of the first American microscope builder, Charles Spencer, this organization has kept in close contact with the science of geometrical optics and contributed to its progress. The prime importance of this science for continuous development of superior and efficient methods in optical design has contributed to the improvement of the performance of microscopes.

It is true that the resolving power of the microscope and the contrast within the image depends on the perfection of the definition. Maximum resolving power can only be obtained if the image-forming action of the lens is flawless. However, even when the definition is perfect we cannot reach an unlimited resolution of objects, since an insurmountable boundary is set by nature through the finite wave length of light. As a consequence of the wave theory of light, one finds that the light energy which is radiated from a point source is distributed over a certain area and focuses in one given image point, even if the image-forming action of the lens is perfect. Instead of a point image, a diffraction disc of finite dimensions is seen whose dimensions cannot be smaller than a certain fraction of the wave length of light. This causes a limit of the resolution which can be shown by the formula  $\gamma = \frac{\lambda}{2NA}$  where  $NA$  is the numerical aperture of the objective.

This limit is considerably greater if the lens system is not completely corrected and the resolving power is considerably improved. For a full understanding and

*achromat with lens Diaphragm  
left: Achromat, right: Achromat, right: Achromat.*





ingment of the perfection of a lens, the designer then often has to employ, in addition to methods based on geometrical optics, other methods derived from wave optics. This knowledge of wave optics plays an especially important part in the determination of tolerances for which the lens system should be manufactured.

Recent results in the wave optical interpretation of the image have demonstrated the influence which the construction of the lens may have on the contrast of the details in the image. The aim of obtaining images of maximum contrast then represents an additional problem in the improvement of microscopes. Work on this problem has provided us with instruments which have set new standards of performance, and continuing research should lead to even better optical designs in the future.

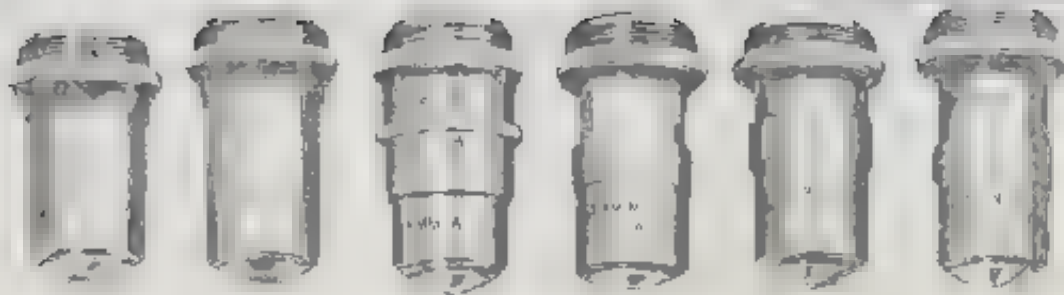
The materials available for the use of the optical designer have grown in number and quality. Charles A. Spencer made his own optical glass during the middle of the 19th century. He also used natural materials such as flintite. Optical glass manufacture was developed greatly in Europe during the latter half of the century and was taken up again by Americans during the First World War. We met our needs during this period by establishing an optical glass plant at Hamburg, N. Y.

For many years fine optical glass has been available from several sources in the United States as well as Europe and the optical designer has had a rapidly growing choice of refractive indices and dispersions. Now, unusual glasses have been made from rare oxides and are available to AO lens designers.

Good workmanship interprets careful design and proves the work of the designer. Experimental lenses are made and tested to check every new design, to see that it fulfills its purpose and to determine if it can be produced economically. Good workmanship is revealed in the uniformity of the lenses and mountings. Like lenses are interchangeable optically as well as mechanically. An exhaustive inspection routine guards the quality of Spencer instruments and accessories. The centering, splicing, parcentering and parfocalizing of AO Spencer objectives are examples of good workmanship.



2 inch, 7 inch, 10 inch, 12 inch, 14 inch, 16 inch, 18 inch, 20 inch, 22 inch



*Apochromatic Objectives, left to right, 16mm, 25mm, 35mm, 45mm, 55mm, 65mm. N.A. 1.30, 1.40, 1.45, 1.50, 1.55, 1.60.*

## Spencer Microscope Objectives

### Apochromatic Objectives

Of all types of microscope objectives, the apochromats represent the closest approach to perfect definition. The most common defects in microscope objectives are the failure of light of different wave lengths of the spectrum to focus at the same point (Chromatic aberration) and the failure of light entering different zones of the lens to focus at the same point (Spherical aberration). These defects are overcome to a remarkable degree in apochromats, which are corrected chromatically for three colors of the spectrum, and spherically for two, whereas in the achromatic objectives the corrections are limited to two colors and one respectively. The natural crystal, fluorite, is used to make some of the lens elements. With glass alone

it is not possible to obtain the necessary corrections.

Apochromats are used for the most critical microscopy, both for visual work and for photomicrography. They are especially useful in photomicrography where color is to be reproduced.

Because of the greater perfection of axial color correction in apochromatic objectives, the oblique color error is of necessity somewhat greater. To compensate for this residual color error, it is necessary to use these objectives in combination with compensating eyepieces. A microscope having an optical system with apochromatic objectives and compensating eyepieces must also have an achromatic condenser to obtain the best possible performance.

	Approx. Focus mm.	Linear Magnification	Type	Numerical Aperture	Working Distance mm.
	6	10	dry	0.30	
	8	10	dry	0.60	
	11	44	dry	0.95	10
	13	60	dry	0.95	10
	13	60	oil imm.	1.30	
	13	60	oil imm.	1.40	
	12	90	oil imm.	1.40	
	12	90	oil imm.	1.40	
	12	90	oil imm.	1.40	
	12	90	oil imm.	1.40	

\*Furnished in color as assistant mounts.

\*\*With iris diaphragm.



### Fluorite Semi-Apochromatic Objectives

The Fluorite objectives occupy a position between apochromatic and achromatic objectives in performance and cost. They are

*Fluorite Objectives*



used where the extremely fine correction of apochromats is not required. Their moderate cost is the result of their con-

struction, which is similar to that of the achromatic objectives, with some pieces of fluorite crystal used instead of glass.

Obj. No.	Equiv. Focus mm.	Initial Magnification	Type	Numerical Aperture	Working Distance
230	15	97	oil imm.	1.70	

### Achromatic Objectives

Spencer achromatic objectives have been developed to obtain optimum resolving power and definition with simple, economical construction. The chromatic and spherical corrections are so adjusted that the image is remarkably crisp and free from color.

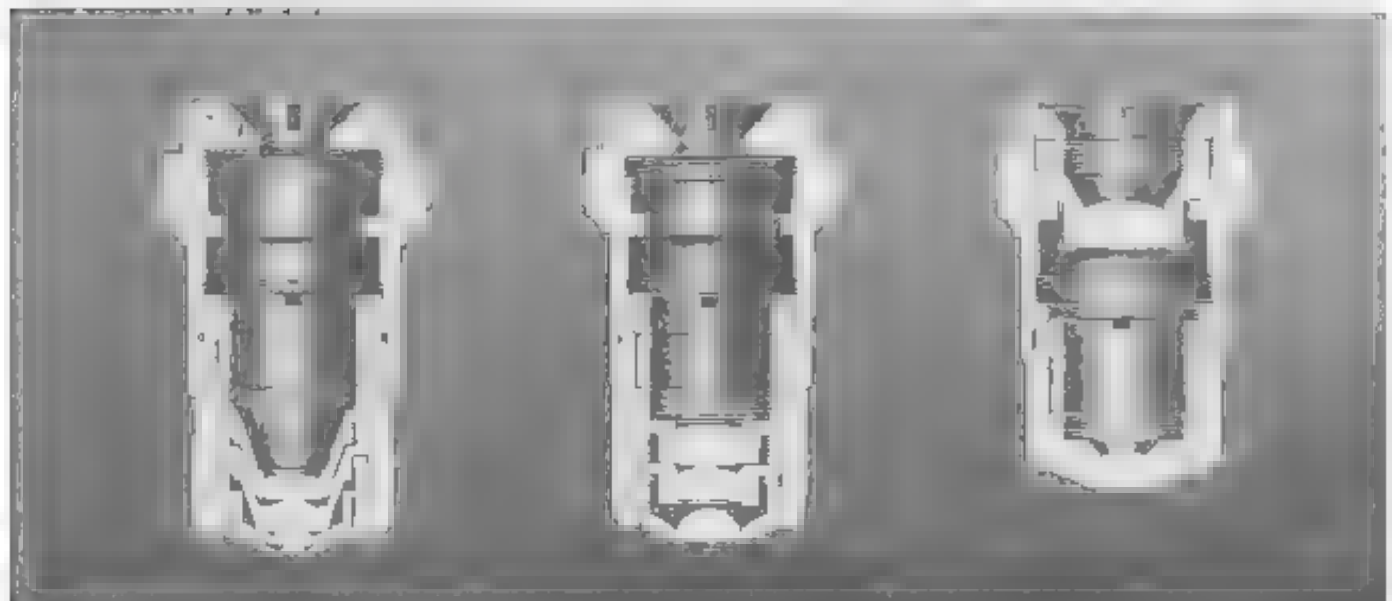
Achromatic objectives are used for most microscopic work, both visual and photo-

graphic, in which extremely critical optical performance is not required. The consistently fine performance of Spencer achromatic objectives is universally recognized and is a result of their excellence of design and construction.

The following listing of objective specifications will help you to select the most suitable optics for your work.

		Initial Magnification		Aperture	Working Distance
1	5	20		0.06	5
2	10	40		0.10	4
3	15	60	dry	0.15	3
4	20	80	dry	0.17	2.5
5	25	100	dry	0.25	2
6	30	120	dry	0.30	1.5
7	35	140	dry	0.36	1.2
8	40	160	dry		1
9	45	180	dry		0.8
10	50	200	dry		0.7
11	55	220	dry		0.6
12	60	240	dry		0.5
13	65	260	dry		0.4
14	70	280	dry		0.3
15	75	300	dry		0.2
16	80	320	dry		0.1
17	85	340	dry		0.1
18	90	360	dry		0.1
19	95	380	dry		0.1
20	100	400	dry		0.1
21	105	420	dry		0.1
22	110	440	dry		0.1
23	115	460	dry		0.1
24	120	480	dry		0.1
25	125	500	dry		0.1
26	130	520	dry		0.1
27	135	540	dry		0.1
28	140	560	dry		0.1
29	145	580	dry		0.1
30	150	600	dry		0.1
31	155	620	dry		0.1
32	160	640	dry		0.1
33	165	660	dry		0.1
34	170	680	dry		0.1
35	175	700	dry		0.1
36	180	720	dry		0.1
37	185	740	dry		0.1
38	190	760	dry		0.1
39	195	780	dry		0.1
40	200	800	dry		0.1
41	205	820	dry		0.1
42	210	840	dry		0.1
43	215	860	dry		0.1
44	220	880	dry		0.1
45	225	900	dry		0.1
46	230	920	dry		0.1
47	235	940	dry		0.1
48	240	960	dry		0.1
49	245	980	dry		0.1
50	250	1000	dry		0.1

Illustration of Spencer Objectives. Left to right: 10mm, 4mm, 16mm.





## Spencer Microscope Eyepieces

### Huyghenian Eyepieces

Huyghenian Eyepieces are usually supplied for visual work and are standard equipment of High School, Laboratory and Medical Microscopes. They contain two plano-convex lens elements. The focal plane is between these lenses and the diaphragm provides a convenient holder for reticles or scales used when counting or measuring details in the field.

Cat. No.	Power	Price	
		Cat. No.	Power
136	5X	"	"
138	6X	"	"
140	8X	"	"
142	10X	"	"
143	16X	"	"
144	12X	"	"

### Wide Field Eyepieces

Wide Field Eyepieces for use with compound microscopes provide a large field. They are especially appreciated by pathologists in the examination of sections of blood and bacterial smears. The corrections attained by additional lenses in the eyepieces permit the use of a larger diaphragm in the eyepiece, thus providing a larger field.

Cat. No.	Power	Price	Cat. No.	Power	Price
145	10X		146	8X	
147	15X		148	10X	
149	20X		150	10X	

### Ramsden Eyepieces

Ramsden Eyepieces are particularly well suited optically for the use of scales or reticles for measuring or counting. Paired Ramsden Eyepieces are often included in the Junior Stereoscopic Microscopes. They can be used with achromatic or fluorescent objectives.

Cat. No.	Power	Price	Cat. No.	Power	Price
177	6X		178	6X	
178	10X		179	10X	
179	15X		180	15X	

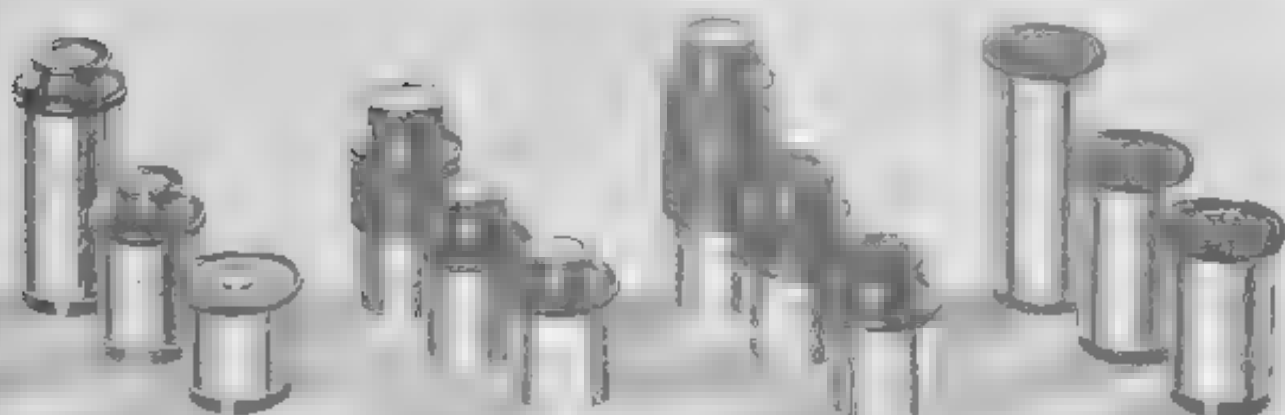
### Compensating Eyepieces

In apochromatic objectives the oblique color error is not corrected to the same degree of perfection as is the axial color. The compensating eyepieces have been designed to compensate for the residual oblique color of apochromatic objectives. Because of their higher degree of correction, compensating eyepieces are frequently used in making photomicrographs with achromatic objectives.

SINGLE			PAIRED		
Cat. No.	Power	Price	Cat. No.	Power	Price
155	5X		156	5X	
156	5X		157	5X	
157	5X		158	10X	
158	10X		159	10X	
159	12X		160	12X	
160	15X		161	15X	
161	20X		162	20X	
162	30X		163	30X	

\* High Eye Point

Illustrations are for reference only. Prices are subject to change without notice.

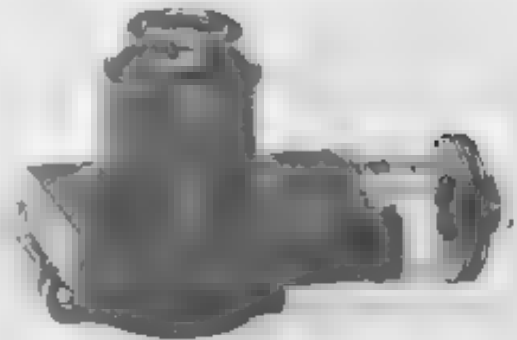




## Screw Micrometer Eyepiece

This micrometer eyepiece represents the highest type of precision in construction and guarantees the greatest possible precision of measurement. Instead of the usual cross hairs, a finely-ruled glass scale is used, the center line of which is replaced by a V. This V serves in the usual way as a reference point for the scale. Each interval in the scale is exactly equivalent to one revolution of the screw which moves fractions of a revolution of this screw are indicated by a drum graduated into 100 parts. The drum may be rotated on the screw axis to adjust its zero reading to any required position. This system has important advantages, especially in the measurement of large objects. Unlike other micrometers, it does not require the reversing of the index over the entire length of the object as a fraction of one rotation of the screw will do that is ever necessary.

In measuring the length of an object the scale is moved until one of the millimeter lines coincides with the margin of the object under examination, and then, by noting the amount of revolution necessary to bring another line into coincidence with



Model No. 425 Micrometer Eyepiece

the opposite side, the fractional part of the last division can be read to hundredths.

The scale has thirty divisions, with each tenth division indicated by a numbered line of double length.



## Method of Calibrating Micrometer Discs for Eyepieces

All of the scales placed in the eyepieces have arbitrary length, and the apparent length depends on the magnification. Consequently, each scale has to be calibrated for use with each combination of objective and eyepiece. To calibrate, the specimen is placed on the stage micrometer and moved until one of the divisions of the specimen corresponds exactly with one of the divisions of the eyepiece micrometer.

The true distance ( $x$ ) seen on the stage micrometer, which corresponds to the number of divisions ( $y$ ) of the eyepiece

micrometer is then read, and dividing this true distance by the number of divisions of the eyepiece micrometer, we find the distance each one subtends ( $c = x/y$ ). The number of divisions covered by the specimen, multiplied by the calibration constant ( $c$ ), gives the length of the specimen. Once an eyepiece micrometer has been calibrated, it need not be recalibrated when used with the same eyepiece. The same objective and the same tube length. If the tube length of the microscope with adjustable draw tube is changed, these values change proportionally, and this may bring the values of the eyepiece scale to an even value. A slight movement of the draw tube causes little loss of definition, but any change in tube length from the correct value of 160 mm. increases the spherical aberration and reduces the definition. If some detail need not be resolved a certain amount of distinctness in the image may be sacrificed for convenience in calibrating the eyepiece scale.



Calibration of Eyepiece Reticles



## Measuring and Counting Accessories

Micrometer discs and reticules are glass discs having finely etched scales. They are placed in the microscope eyepiece for the purpose of measuring or counting objects viewed through the microscope or to limit the field observed.

Spencer discs are supplied in two diameter sizes. The 20.0mm. discs fit old style Huyghenian eyepieces in which the flange of the diaphragm turns up, and also the eyepieces of Spencer Stereoscopic Microscopes. The 21.15 diameter discs fit Spencer

Huyghenian eyepieces (as well as B. & L. Leitz, and Zeiss) in which the flange of the diaphragm turns down. The 21.15 diameter discs are also suitable for the Ramsden and Wide Field eyepieces listed for compound microscopes.

The linear value of the graduations on a micrometer disc must be determined by a comparison of it with a standard scale piece with which it is used. The Catalog No. 400 Stage Micrometer provides an accurate scale for determining these values.

Illustrations	Cat. No.	Name	Dia. in mm.	Rating	Price
	405	Micrometer Disc	21.15	3mm. scale divided into 50 parts	
	410	Micrometer Disc	21.15	3mm. scale divided into 100 parts	
	415	Micrometer Disc	21.15	3mm. scale divided into 200 parts	
	414.9	Micrometer Disc	20.0	3mm. scale divided into 50 parts	
	408	Net Micrometer	20.0	10mm. square divided into 100 1mm. squares	
	1409	Net Micrometer	20.0	10mm. square divided into 400 .5mm. squares	
	421	Net Micrometer Reticule	20.0	3mm. square divided into 25 1mm. squares	
	422	Net Micrometer Reticule	21.15	3mm. square divided into 100 .5mm. squares	
	427	Cross Hair Disc	21.15		
	1427	Cross Hair Disc	20.0		
	472	Spinner Wrench for Diaphragm of NO. 84, 86 and 187 eyepieces.			



## Howard Mold Count Equipment

These accessories are especially designed for determination of mold content in food products, although they can be adapted to other uses.

Mold Count Discs are ruled into squares, each of which is equal in 1/6 the diameter

of the field. The microscope must be calibrated with disc in place to give field diameter of 1.382mm.

The counting chamber is of standard one-piece construction and is supplied with two cover glasses.

Catalog  
No.

Description

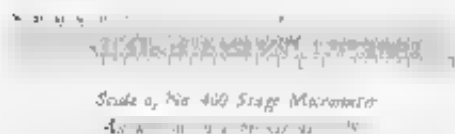
Price

- 413 Howard Mold Count Disc, 7.5mm diameter for use in No. 42 Huyghenian eyepiece, 10X
- 413 Howard Mold Count Disc, 20.0mm diameter for use in No. 142 Huyghenian eyepiece, 10X
- 417 Howard Mold Counting Chamber used with No. 413
- 418 Cover Glass, .9mm. thick for Howard Mold Counting Chamber
- 419 Cover Glass, .5mm. thick for Howard Mold Counting Chamber

## Stage Micrometer

The Spencer Stage Micrometer is a rectangular glass slide with a photographic scale (2mm. long, divided into 100 parts). This accessory is used for calibrating any

of the eyepiece micrometer discs and for measuring field size. A simple method of calibrating eyepiece micrometers is described on preceding pages.



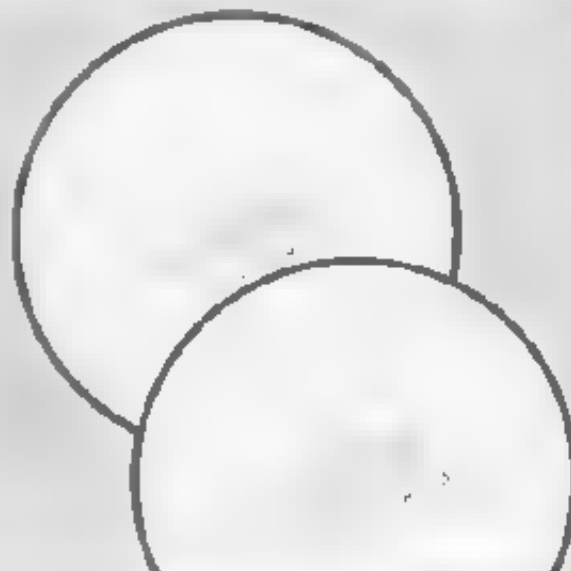
## Micrometer Eyepieces — Fixed Scale

The eyepiece of a micrometer eyepiece is focusable by spiral action so that the micrometer scale can be brought into sharp focus. The micrometer disc is screwed to the focusing sleeve and is so designed that it can be rotated quickly and easily for cleaning.

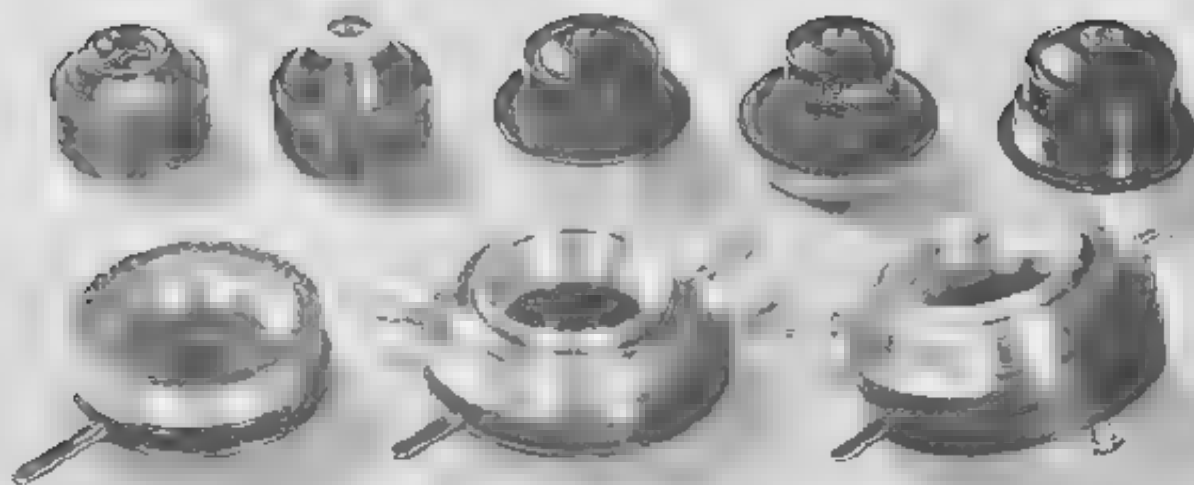
Diagram of the eyepiece of a micrometer eyepiece, showing the scale of the micrometer eyepiece No. 420.



- 415 Micrometer eyepiece, 6X, 5mm. scale divided into 50 parts
- 420 Micrometer eyepiece, 10X, 5mm. scale divided into 100 parts







Left to right: Condensers Nos. 302, 303, 304, 305, 306, 307, 308, and 309. The mounts are shown separately on the opposite page.

## Spencer Microscope Condensers

Microscope condensers and the mounts that hold them are listed separately. The type of mount to order is determined by the construction of the microscope and by the facilities needed, such as centering and oblique light.

Most Spencer Laboratory and Research Microscopes have the fork-type substage construction and any fork-type mount can be used.

For a microscope with a substage ring (either quick screw, rack and pinion, or spiral focusing), the outside diameter of the mount should be specified.

Consult the chart on the opposite page for catalog numbers of mounts for various condensers.

Spencer Microscope Condensers Nos. 306 to 311 are ideal when only the lower medium powered objectives are used. Their numerical aperture of 0.66 provides full illumination for objectives up to the 4mm. and saves the re-focusing that would

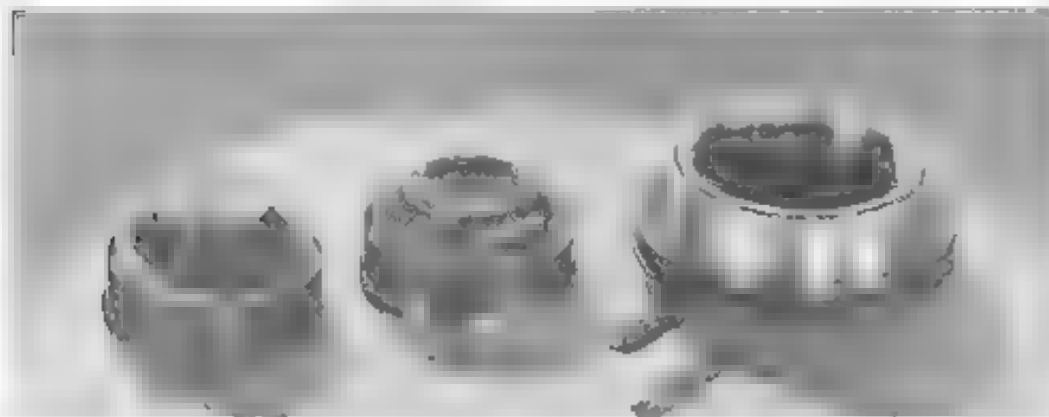
be necessary if a lower power objective were used.

Spencer Nos. 302 and 304 Abbe-type condensers contain two lens elements and are the ones supplied as standard equipment on medical microscopes. With the top element in place it will illuminate fully the aperture of all objectives from the 1.8mm. oil immersion to the 16mm. low power. The top element can be easily removed, increasing the area of illumination so that the field of long focal length or low power objectives can be illuminated evenly.

The Spencer No. 305 wide angle condenser is a three-lens system. It has a numerical aperture of 1.40 and is an efficient inexpensive condenser for use with high aperture objectives.

In conformity with the policy of offering the best possible equipment for each individual problem, two achromatic condensers are offered. They are fully applanatic

Left to right: Condensers No. 4, 2.25, No. 4.0, 6x, and the No. 23 Lens Diaphragm Ring Mount for these condensers.





ic as well as achromatic, and manufactured to the same standard as Spencer objectives. Microscopes using apochromatic objectives and compensating eyepieces must always be furnished with an achromatic-aplanatic condenser to obtain the full benefit of the highly corrected eyepiece.

The Spencer No. 320 achromatic-aplanatic condenser N. A. 1.40  $\lambda$  rays should be used with an objective having a numerical aperture greater than 1.30.

The Spencer No. 313 N. A. 1.30 achromatic-aplanatic condenser of the same general design as the N. A. 1.40, but has such features that make its use desirable whenever an objective of N. A. 1.30 or less is used. It will give better performance than the N. A. 1.40 wherever it can be used without sacrificing numerical aperture in the objective.

All Spencer condensers will illuminate the full field of a 16mm. objective without requiring special adjustment of any kind.

No. 333 Auxiliary Condenser is an extra condensing lens for use below the regular condenser. It raises the focal point of the condenser so that the apex of the cone of light is raised about 10mm. above the surface of the stage. This makes an excellent illumination at this height for drop culture work, and a larger area at the plane of the stage for use with low power objectives. It is so mounted that it is easily attached and can be swung in or out of the optical system by simple lever action.

Catalog No.	Description	Catalog No.	Description
302	Absbe Condenser N. A. 1.25 for use in	320*	Achromatic and Aplanatic Condenser
303	" " " " " "	321	Auxiliary Condenser
304	Wide Angle Condenser N. A. 1.40		
305	Absbe Condenser N. A. 0.66 with diaphragm for use in ring-type mounts		
313	Absbe Condenser N. A. 0.66 with diaphragm for use in fork-type mounts		
315*	Achromatic and Aplanatic Condenser		
320*	Achromatic and Aplanatic Condenser		
321	Auxiliary Condenser		

The above description and illustrations are for the condensers only. Condenser mounts are listed separately below.

324 Non-contrast condenser mounting with iris diaphragm for fork-type sub-

stages. Same as above for No. 303 Condenser with iris diaphragm for quick screw mount.

Centerable mounting with iris diaphragm for fork-type substage. Used with No. 302 and No. 313 Condensers. Same as above for No. 315 Condenser.

Same as above for No. 320 Condenser with iris diaphragm for quick screw mount.

Centerable mounting with iris diaphragm for fork-type substage. Used with No. 302 and No. 313 Condensers. Same as above for No. 315 Condenser.

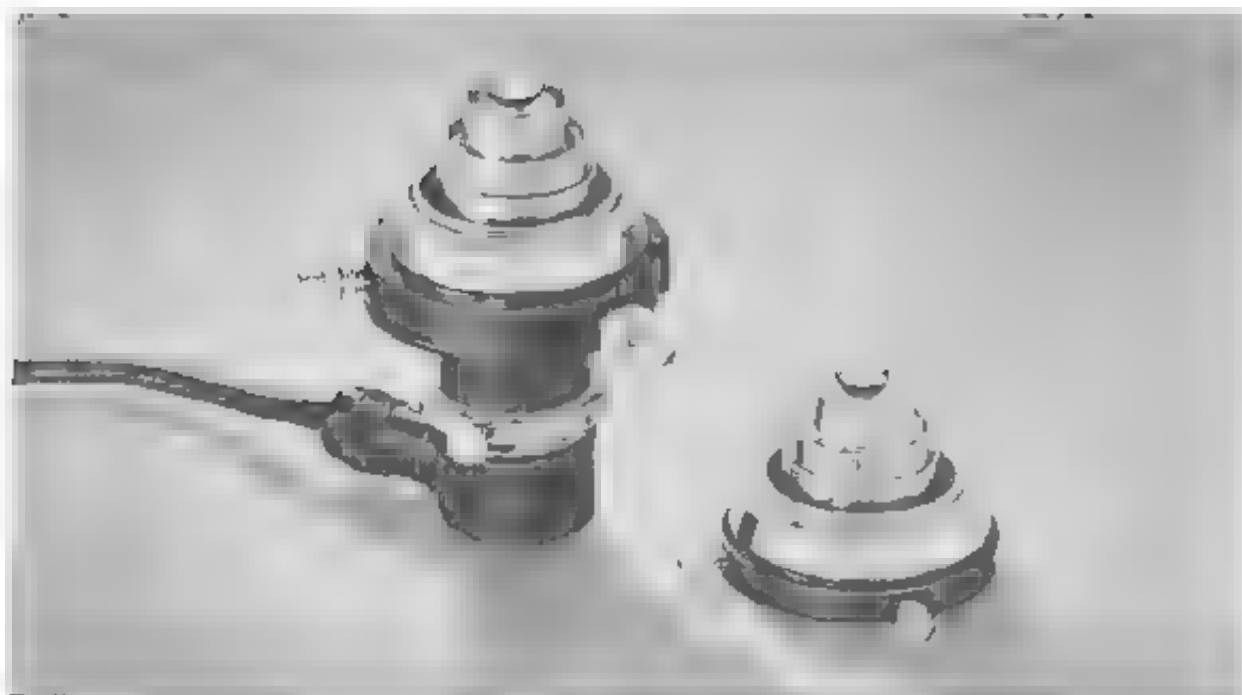
\* A centerable mounting should also be used with an achromatic condenser.

## Condenser and Mount Combinations

Catalog No.	Description	Catalog No. of Non-Contrastable Mount	Catalog No. of Contrastable Mount	Catalog No. of Contrastable Mount with Oblique Light
302	35 Absbe	324	326	
303	40 Wide Angle	324	326	327
313	30 Achromatic Aplanatic	324	322	329
320	40 Achromatic Aplanatic	324	321	329

For Spencer Ring Type Substage

Catalog No.	Description of Condenser	Catalog No. of Non-Contrastable Mount
306	0.66	325
304	1.25 Absbe	325



Dark Field Illuminators, left, No. 326 with built-in lamp, right, No. 327

## Dark Field Illuminators

The dark field illuminator is now accepted as a standard accessory to the microscope, replacing the substage condenser for certain types of work.

All dark field illuminators listed below are identical optically and vary only in mechanical construction to fit different types of substage equipment. Adjusting screws are necessary for accurate centering the optical unit and must be an integral part of the illuminator on a proper or the substage equipment in which it is used.

There are two types of illuminators - one using a separate microscope lamp of sufficient intensity, the other having the illuminator which is an electric light (6V-1.7 Amp) with its condensing lens integral such as in Catalog No. 328. This is the newest, most satisfactory, and most easily adjusted instrument, being designed with two sets of concentric adjusting screws: one for centering the illuminant, the other for the optical unit.

Successful dark field illumination is secured with an objective of 0.85 numerical aperture. This aperture is obtained with either a funnel stop properly placed in objectives of greater N.A. or by using an objective in which is built an iris diaphragm.

No.	Description	Price
328	Dark Field Illuminator with built-in light source in the simplified rack and pinion substage. Includes one bulb and its protective stop (transformer or resistance coils).	
329	Same as No. 328 to fit research work-type substages.	
330	Same as No. 328 to fit quick screw substage.	
331	Resistance to adapt No. 334 bulb to 220 v. a.c. current A.C. or D.C.	
332	Resistance to adapt No. 334 bulb to 110 v. a.c. current A.C. or D.C.	
333	Transformer to step down 110 v. to increasing current to 6.5 volts.	
334	Variable transformer to step down 110 v. to A.C. current 60 cycle to 6.5 v. or less.	
335	Bulb—6.5 V., 1.7 amp. for above. M.C.P.	
336	Bulb—6.5 V., 1.7 amp. tested for use with No. 32 Dark Field Illuminator. M.C.	
337	Dark Field Condenser without lamp, designed for use with research type microscope.	
338	Same as No. 337 to fit quick screw substage but with centering mount.	
339	Same as No. 339 to fit simplified rack and pinion substage.	

Note: Special funnel stops must be made for objectives other than our own manufacture and for this work a slight additional charge is made. The objectives should be sent to the factory to insure proper fitting.



## Spencer Fluorescence Accessories

By means of this inexpensive set of accessories any standard monocular microscope can be converted to a simple fluorescence microscope. Acidfast bacteria, gonorrhea, including those of tuberculosis and syphilis can then be identified by the

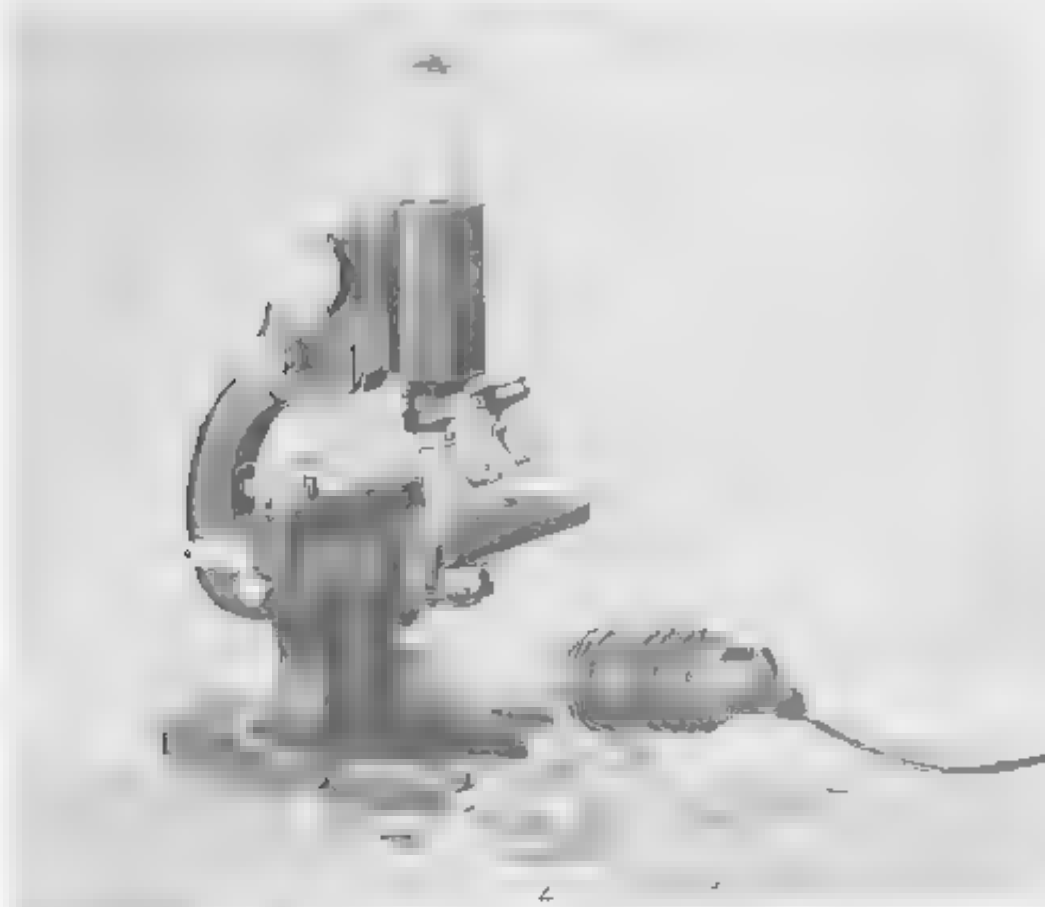
following accessories:

Extreme contrast makes the bacteria easily recognizable at the comparatively low magnification of 400 diameters. They can be located with an 8 mm. objective, 20X compensating eyepiece combination, and the resulting wide field makes possible a saving of one-fourth to one-third in the time required for search.

Designed for use with Spencer Nos. 349, 351 or 353 lamps, it consists of a yellow filter to fit in the microscope eyepiece (1), an aluminum mirror to fit over the usual mirror (2), and an ultra-violet filter to fit the lamp (3).

Cat. No.	Description	
353	Fluorescence Accessories for No. 353 lamp	
353	Universal Microscope Lamp with 6.3 volt, 1.75 ampere clear bulb with blue glass and transformer	

\* See description on opposite



1. Yellow Eyepiece Filter 2. Aluminum Filter  
3. Ultra-violet Filter for Lamp



## Spencer Magnifiers

These Magnifiers are computed with the same care and manufactured by the same exact methods as are employed in the construction of other Spencer high grade optical products. They will be found to be of uniformly excellent quality and to adhere rigidly to the specifications by which they are described.

Two different styles of mountings are offered according to the different purposes for which they are used. The A mounts

are black lacquered brass for dissecting microscopes, C mounts, in folding case, are chromium plated.

DOUBLETS are composed of two plano-convex lenses accurately ground and polished and suitably mounted.

TRIPLE APLANATS are corrected, both spherically and chromatically. They are remarkable for their large flat field, freedom from distortion, brilliancy of illumination, and greater working distance.

	Catalog No.	Magnification	Mil. Dia.	Working Distance in Inches	Working Distance in mm.	Diameter of Field in mm.	Mount	Purpose
Magnifiers	202	6X	41.6	1.6	27	22	A for	Dissecting Microscopes
	204	9X	27.8	1.1	15	16		
	205	12X	20.8	0.8	12	11		
	227	6X	41.6	1.6	27	22	C	Folding Case
	228	9X	27.8	1.1	15	16		
	229	12X	20.8	0.8	12	11		
Magnifiers	259	6X	41.6	1.6	36.8	30	A for	Dissecting Microscopes
	260	12X	20.8	0.8	24.5	20		
	261	18X	13.9	0.5	18.4	13		
	276	6X	41.6	1.6	36.8	30	C	Folding Case
	277	9X	27.8	1.1	24.5	20		
	278	12X	20.8	0.8	18.4	13		



Left Doublet Magnifier in C Mount Right Triplet

Next left, Doublet in A Mount right Triplet Aplanat in A Mount



The Spencer Utility Magnifier No. 623

## Utility Magnifiers

A magnifier is of value in investigating any details or characteristics which are too small for the unaided eye to see clearly. When a magnifier is placed in front (and close) to a human eye, it increases the apparent size of the object under examination, thus increasing the detail visible to the eye.

The Spencer Utility Magnifier is designed to cover the largest uses for such an instrument: dissection, inspection of minerals, textures, paper castings, insects, and foreign objects. The lens is held in position by the lens ring, which is adjusted to the proper focal distance. The 4.5X lens, having three lens elements, is corrected for chromatic and spherical aberrations. The lens is 36mm in diameter. It gives an extremely large field.

No.		Price
623	Spencer Utility Magnifier, 4.5X lens, 36mm diameter, 36mm focal length, 36mm field of view	\$1.00
624	Spencer Fingerprint Magnifier, same as above but with base milled to accept and align fingerprints	\$1.00
627	Henry D. Spencer Utility Magnifier, 4.5X lens, 36mm diameter, 36mm focal length, 36mm field of view	\$1.00



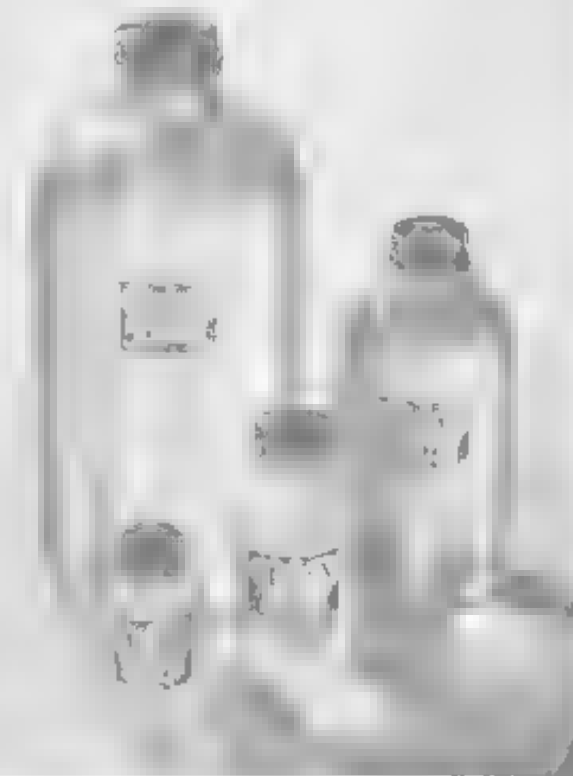
## Immersion Oil

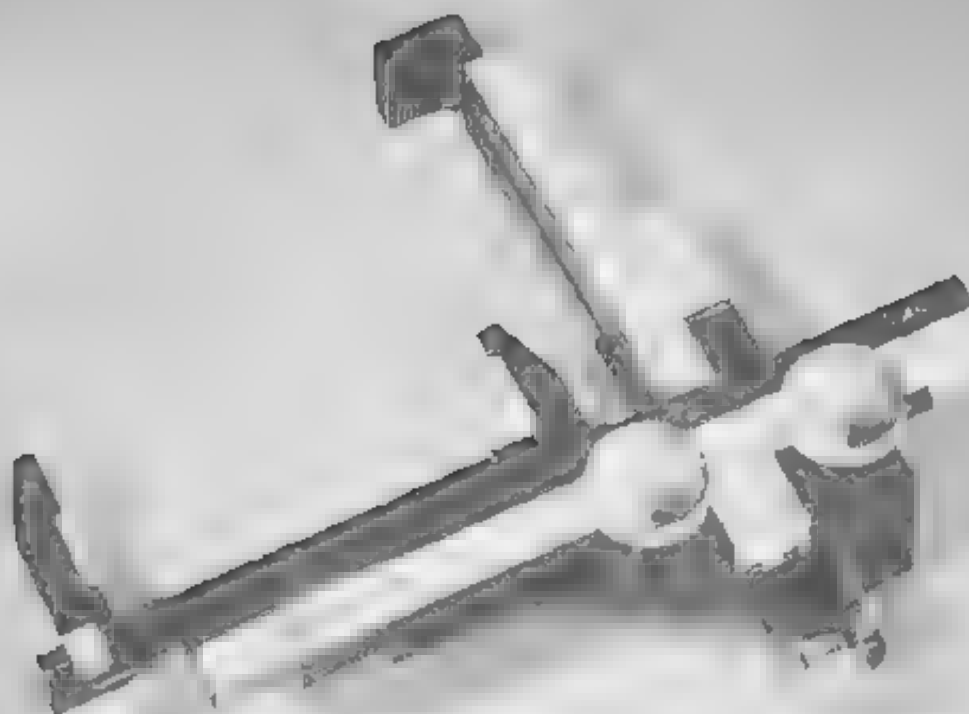
Crown Immersion Oil is a synthetic product developed to meet the exacting requirements of microscopy. Optically it has an  $n_D$  of 1.515 and a dispersion about equal to that of cedarwood oil. It is non-toxic, non-corrosive, and does not stain the objective or cover glass. Because it is easily applied and removed, it has largely replaced cedarwood oil in many laboratories.

Cedarwood oil is also available for immersion optics when may prefer it.

No.	Product	Price
6140	Crown Immersion Oil, 1 oz. in plain bottle	\$1.00
6142	Crown Immersion Oil, 4 oz. in plain bottle	\$3.00
6143	Crown Immersion Oil, 4 oz. in plain bottle	\$3.00
6144	Crown Immersion Oil, 1 pt. in plain bottle	\$6.00
6130	Cedarwood Immersion Oil, 1/2 oz. in plain bottle	\$1.00
6132	Cedarwood Immersion Oil, 1 oz. in plain bottle	\$2.00
6133	Cedarwood Immersion Oil, 4 oz. in plain bottle	\$6.00
6134	Cedarwood Immersion Oil, 1 pt. in plain bottle	\$12.00

Crown Immersion Oil





*No. 485 Mechanical Stage*

## Spencer Mechanical Stages

Spencer Mechanical Stages, for square stage microscopes, are designed to facilitate the complete exploration of a slide. Four of the stages are graduated so that the positions of selected fields in the specimen may be recorded and located again. The verniers on stages Nos. 489 and 490 are

adjustable. The adjustable verniers are desirable if the mechanical stage is to be used on more than one microscope; they provide for correcting the readings of the graduations so that areas observed and recorded on one microscope can be re-located on a different microscope.



ed to fit plain square stages with slides 105mm. or larger. They may be fastened in place quickly or removed as easily.

combrances. They are built sturdily with smooth and positive rack and pinion movements in both directions. Smoothness is attained through special bearing construction.

ly the position it is wanted. The extreme edge of the slide can be brought in focus without any part of the mechanical stage striking the objective. All mechanical stages are finished in durable black and

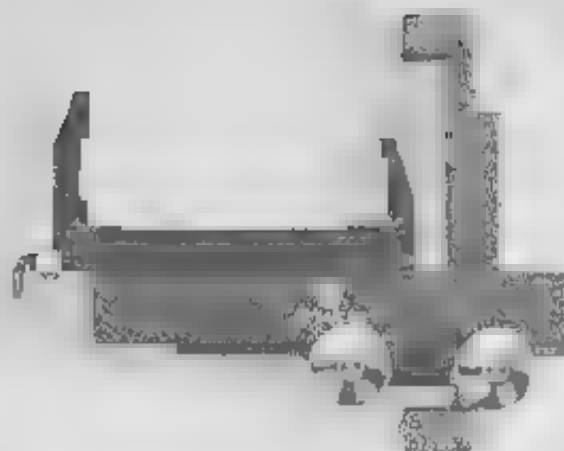
436

No. 484 Mechanical Stage has a total movement of 50mm. and a lateral movement of 75mm. It accommodates slides 25 x 75mm. and 50 x 75mm., but is not graduated. It may be used on any Spencer square stage microscope.

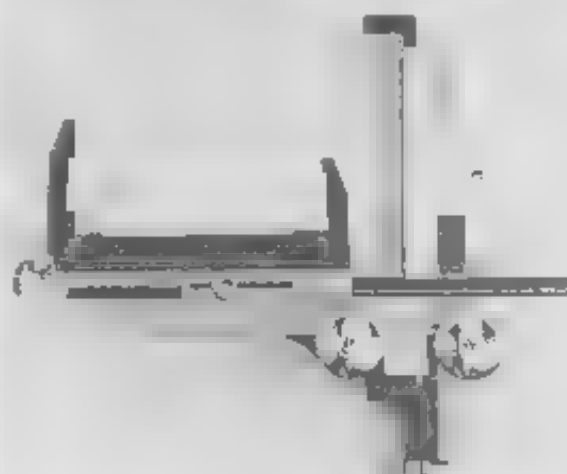
No. 485 Mechanical Stage is heavier than No. 484 and has graduations and fixed verniers reading to 1/10mm.

No. 489 Mechanical Stage is the same as No. 485 but has adjustments to change the vernier readings, so that readings occurring definite points in a specimen, observed on one microscope, are made available on any other to which the stage is attached.

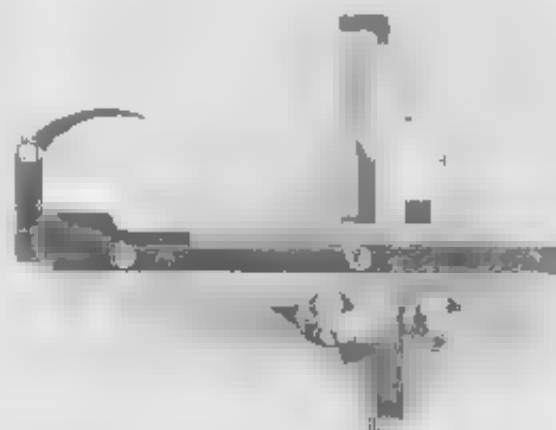
No. 490 Mechanical Stage is like 489 but has a longer lateral rack and special slide clamp designed to accommodate either the 25 x 75mm. or 50 x 114mm. slides such as used in bulk and in daily laboratory work.



No. 484 Mechanical Stage



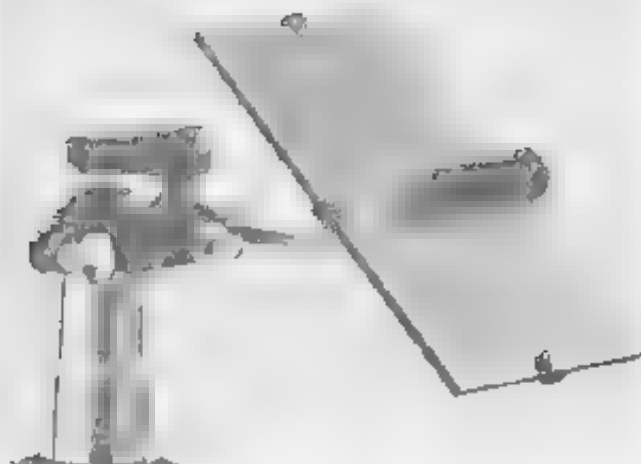
No. 485 Mechanical Stage



No. 489 Mechanical Stage

- 484 Mechanical Stage to take 25 x 75 or 50 x 75mm. slides
- 485 Graduated Mechanical Stage
- 489 Stage as above but with adjustable verniers
- 490 Graduated Mechanical Stage to take up to 50 x 114mm. slides. If case is not desired with adjustable verniers





*The Spencer Camera Lucida No. 500*

## Spencer Camera Lucida

These instruments, of the Abbe-type are now offered for both the regular laboratory microscopes (monobjective) and the stereoscopic microscope, the chief difference being in the mirrors—the larger fields of the latter necessitating larger mirrors.

The entire field of the microscopes can be viewed from above the prism, and the light can be so regulated as to show both the object and the drawing pencil with the same intensity.

In No. 500 two concentric adjusting screws are provided for correctly centering the instrument over the eyepiece.

The entire prism box is hinged to swing on a horizontal axis and is easily thrown out of position for changing eyepieces or for careful examination of the object without the interposition of the prism.

The mirror is supported on an adjustable bar graduated to indicate the distance of the mirror from the microscope. Graduations are also provided to indicate the angle of inclination of the mirror.

In No. 500 the relative intensity of illumination of the object and drawing pencil is regulated by two carefully graded series of neutral tint filters, one between the prism and the eyepiece, and the other between the prism and the mirror.

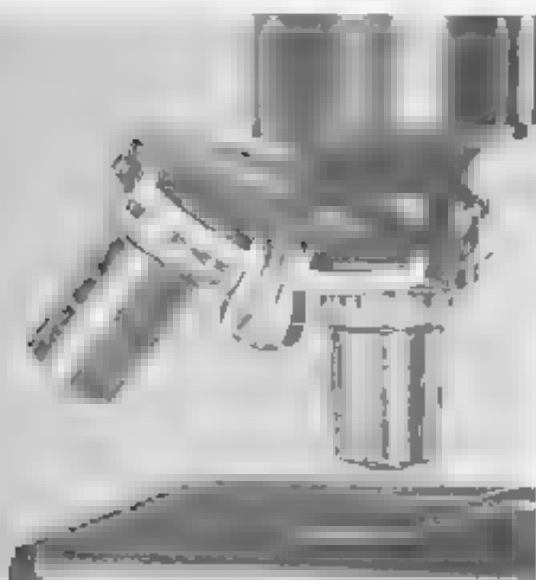
No. 505 differs from No. 500 in the omission of the neutral tint filters between the prism and the eyepiece, and also the centering screws from the prism box.

Cat. No.	Description	Price
500	Camera Lucida in case	
505	Camera Lucida in case	
501	Camera Lucida similar to No. 500 but without neutral tint filters	

## Dual-Cone Revolving Nosepiece

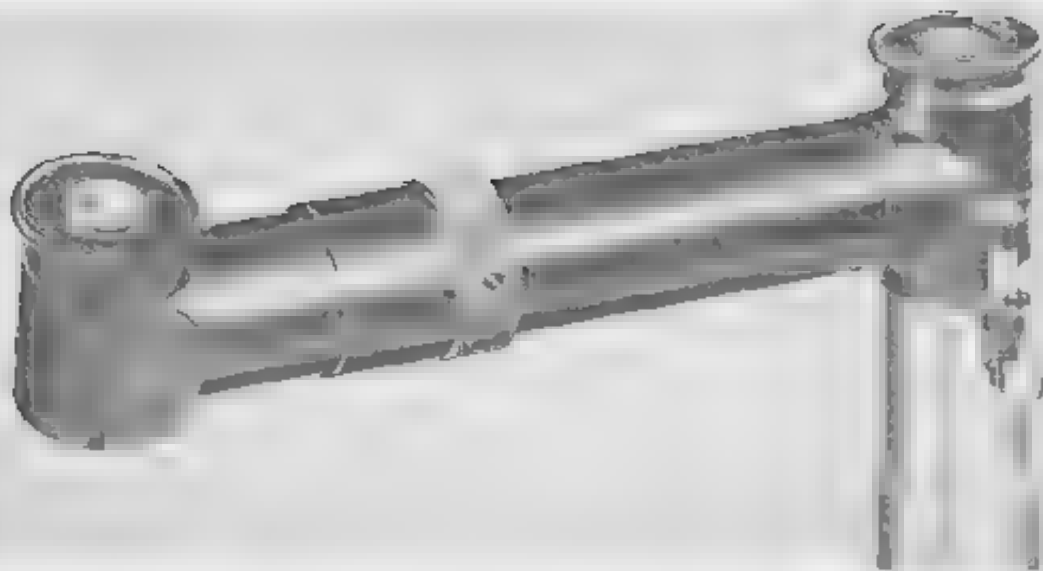
The accuracy of the centering of the objectives on the nosepiece depends upon

*Details of the Dual-Cone Revolving Nosepiece*



the precision with which the part holding the objective revolves. In the Spencer Dual-Cone Revolving Nosepiece the bearing shaft is double the usual length and has two conical bearings that are drawn together with a screw to maintain positive alignment. A spring insures a definite stop centering each objective.

No.	Description	Price
443	Single Objective Adapter	
450	Double Nosepiece	
455	Triple Nosepiece	
460	Quadruple Nosepiece	



*The Spiller Demonstration Eyepiece No. 43.*

## Demonstration Eyepiece

Demonstration eyepieces can be used by any laboratory microscopist to show two persons to view the same field at the same time. They are of inestimable value both for quizzes and study. A conveniently located pointer easily moved to a point of the field is visible at the same time at both eyepieces.

The side tube extends our horizontally and the eyepiece revolves about the axis of the extension tube, so that the user of

the extension can incline his eyepiece at any angle to the vertical that is convenient. The auxiliary eyepiece is focusable independently of the one at the microscope tube by a knurled ring in the extension tube.

	Description	
432	Demonstration Eyepiece with 6X	
434	Demonstration Eyepiece with 6X Eyepieces	

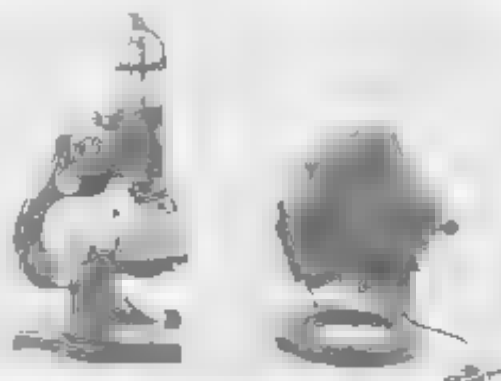
## Microprojection Prism

Some instructors hesitate to pass out to students their more valuable slides or specimens requiring experience for proper illumination. Such subjects can be exhibited by using a prism over the eyepiece and projecting the image onto a ground glass or opaque screen.

Any microscope, preferably one having a substage condenser, can be transformed into a simple microprojector. The brightness of the image, of course, depends the intensity of the light source, as well as upon the magnification, projection distance, room lighting conditions, etc. A low power objective, small screen and short projection distance will give best results.

Cat. No.	Description	Price
346	Prism, 45° type, hinged to clamp which fits standard diameter eyepiece.	

*Microprojection Prism*







## Darkfield Quebec Colony Counter

The new, improved Darkfield Quebec Colony Counter reveals colonies of bacteria clearly against a dark background. The illumination is uniform bright enough to show the smaller colonies used to assist in distinguishing colonies from other structures, yet free from glare. Counting is facilitated while fatigue is reduced.

### Magnification

The new Quebec Colony Counter is designed to give a magnification of 100 times. The illumination is uniform bright enough to show the smaller colonies used to assist in distinguishing colonies from other structures, yet free from glare. Counting is facilitated while fatigue is reduced.

### Illumination

Illumination is brighter than from the previous model. Since the instrument remains cool ventilation is not required and the illuminant is in a closed case. Bulbs can be replaced readily.

### Design

The front surface is inclined at an angle found comfortable for most technicians. An auxiliary tilting base is available where greater or less slope is desirable.

### Guide Plates

A Wolfthuegel guide plate is supplied with the instrument. Stewart and Jeffers guide plates are also available if desired.





### Centering Screws

Centering screws are provided so that the Petri dish may be centered when circularly ruled plates are used

### Case and Finish

The case is built of sheet metal

10  $\frac{1}{16}$ " long

10  $\frac{1}{16}$ " wide

10  $\frac{1}{4}$ " high

The instrument is styled to conform with the modern laboratory and finished in a rich maroon

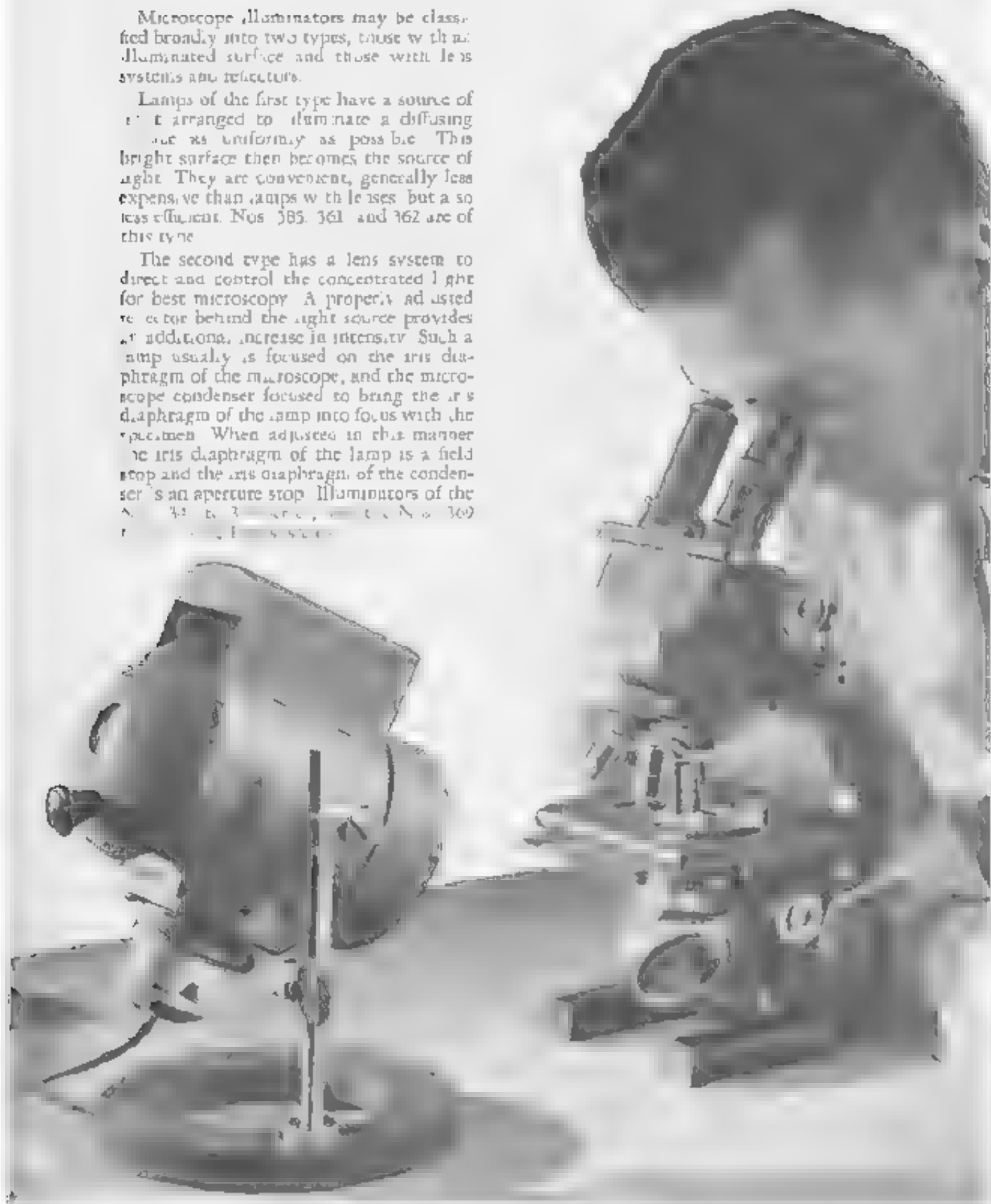
Cat. No.	Description
3330	Spencer Laubeta Quebec Colony Counter with Wolfthugel plate and 40 watt, 110 volt bulb
3339	Same as No. 3330 but with 40 watt bulb
3331	Auxiliary Lamp
3332	Wolfthugel Counting Plate
3333	Stewart Counting Plate
3334	Jeffers Counting Plate
3335	Extra B.O.P., 40 watt 120 volt MCP
3336	Auxiliary Tilting Base
3337	Barra Bulb, 50 watt 230 vo MCP

## Microscope Illuminators

Microscope illuminators may be classified broadly into two types, those with an illuminated surface and those with lens systems and reflectors.

Lamps of the first type have a source of light arranged to illuminate a diffusing surface as uniformly as possible. This bright surface then becomes the source of light. They are convenient, generally less expensive than lamps with lenses, but are so less efficient. Nos. 385, 361 and 362 are of this type.

The second type has a lens system to direct and control the concentrated light for best microscopy. A properly adjusted reflector behind the light source provides an additional increase in intensity. Such a lamp usually is focused on the iris diaphragm of the microscope, and the microscope condenser focused to bring the iris diaphragm of the lamp into focus with the specimen. When adjusted in this manner the iris diaphragm of the lamp is a field stop and the iris diaphragm of the condenser is an aperture stop. Illuminators of the Nos. 342 to 349, 350, 351, 352, 353, 354, 355, 356, 357, 358, 359, 360, 361, 362, 363, 364, 365, 366, 367, 368, 369, 370, 371, 372, 373, 374, 375, 376, 377, 378, 379, 380, 381, 382, 383, 384, 385, 386, 387, 388, 389, 390, 391, 392, 393, 394, 395, 396, 397, 398, 399, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 410, 411, 412, 413, 414, 415, 416, 417, 418, 419, 420, 421, 422, 423, 424, 425, 426, 427, 428, 429, 430, 431, 432, 433, 434, 435, 436, 437, 438, 439, 440, 441, 442, 443, 444, 445, 446, 447, 448, 449, 450, 451, 452, 453, 454, 455, 456, 457, 458, 459, 460, 461, 462, 463, 464, 465, 466, 467, 468, 469, 470, 471, 472, 473, 474, 475, 476, 477, 478, 479, 480, 481, 482, 483, 484, 485, 486, 487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 498, 499, 500, 501, 502, 503, 504, 505, 506, 507, 508, 509, 510, 511, 512, 513, 514, 515, 516, 517, 518, 519, 520, 521, 522, 523, 524, 525, 526, 527, 528, 529, 530, 531, 532, 533, 534, 535, 536, 537, 538, 539, 540, 541, 542, 543, 544, 545, 546, 547, 548, 549, 550, 551, 552, 553, 554, 555, 556, 557, 558, 559, 560, 561, 562, 563, 564, 565, 566, 567, 568, 569, 570, 571, 572, 573, 574, 575, 576, 577, 578, 579, 580, 581, 582, 583, 584, 585, 586, 587, 588, 589, 590, 591, 592, 593, 594, 595, 596, 597, 598, 599, 600, 601, 602, 603, 604, 605, 606, 607, 608, 609, 610, 611, 612, 613, 614, 615, 616, 617, 618, 619, 620, 621, 622, 623, 624, 625, 626, 627, 628, 629, 630, 631, 632, 633, 634, 635, 636, 637, 638, 639, 640, 641, 642, 643, 644, 645, 646, 647, 648, 649, 650, 651, 652, 653, 654, 655, 656, 657, 658, 659, 660, 661, 662, 663, 664, 665, 666, 667, 668, 669, 670, 671, 672, 673, 674, 675, 676, 677, 678, 679, 680, 681, 682, 683, 684, 685, 686, 687, 688, 689, 690, 691, 692, 693, 694, 695, 696, 697, 698, 699, 700, 701, 702, 703, 704, 705, 706, 707, 708, 709, 710, 711, 712, 713, 714, 715, 716, 717, 718, 719, 720, 721, 722, 723, 724, 725, 726, 727, 728, 729, 730, 731, 732, 733, 734, 735, 736, 737, 738, 739, 740, 741, 742, 743, 744, 745, 746, 747, 748, 749, 750, 751, 752, 753, 754, 755, 756, 757, 758, 759, 760, 761, 762, 763, 764, 765, 766, 767, 768, 769, 770, 771, 772, 773, 774, 775, 776, 777, 778, 779, 780, 781, 782, 783, 784, 785, 786, 787, 788, 789, 790, 791, 792, 793, 794, 795, 796, 797, 798, 799, 800, 801, 802, 803, 804, 805, 806, 807, 808, 809, 810, 811, 812, 813, 814, 815, 816, 817, 818, 819, 820, 821, 822, 823, 824, 825, 826, 827, 828, 829, 830, 831, 832, 833, 834, 835, 836, 837, 838, 839, 840, 841, 842, 843, 844, 845, 846, 847, 848, 849, 850, 851, 852, 853, 854, 855, 856, 857, 858, 859, 860, 861, 862, 863, 864, 865, 866, 867, 868, 869, 870, 871, 872, 873, 874, 875, 876, 877, 878, 879, 880, 881, 882, 883, 884, 885, 886, 887, 888, 889, 890, 891, 892, 893, 894, 895, 896, 897, 898, 899, 900, 901, 902, 903, 904, 905, 906, 907, 908, 909, 910, 911, 912, 913, 914, 915, 916, 917, 918, 919, 920, 921, 922, 923, 924, 925, 926, 927, 928, 929, 930, 931, 932, 933, 934, 935, 936, 937, 938, 939, 940, 941, 942, 943, 944, 945, 946, 947, 948, 949, 950, 951, 952, 953, 954, 955, 956, 957, 958, 959, 960, 961, 962, 963, 964, 965, 966, 967, 968, 969, 970, 971, 972, 973, 974, 975, 976, 977, 978, 979, 980, 981, 982, 983, 984, 985, 986, 987, 988, 989, 990, 991, 992, 993, 994, 995, 996, 997, 998, 999, 1000.





## Universal Microscope Lamp

The Spencer Universal Microscope Lamp fills a long felt need for a small illuminator, designed to give all types of illumination generally used in microscopy, as well as providing a compact, adaptable light source for general laboratory work.

It serves as an intense source of light and yet is cool enough to handle and adjust. The lamp house is constructed of aluminum and, in addition to being well insulated, is provided with fins to increase the surface area and dissipate heat. Modern and attractive in appearance, it is universal in application and low in price.

The triple lens condensing system is in a spiral focusing mount and provides support for the filter holder or iris diaphragm. Cobalt, heat-absorbing glass, neutral density or color filters for photomicrographic work may be inserted in the filter holder.

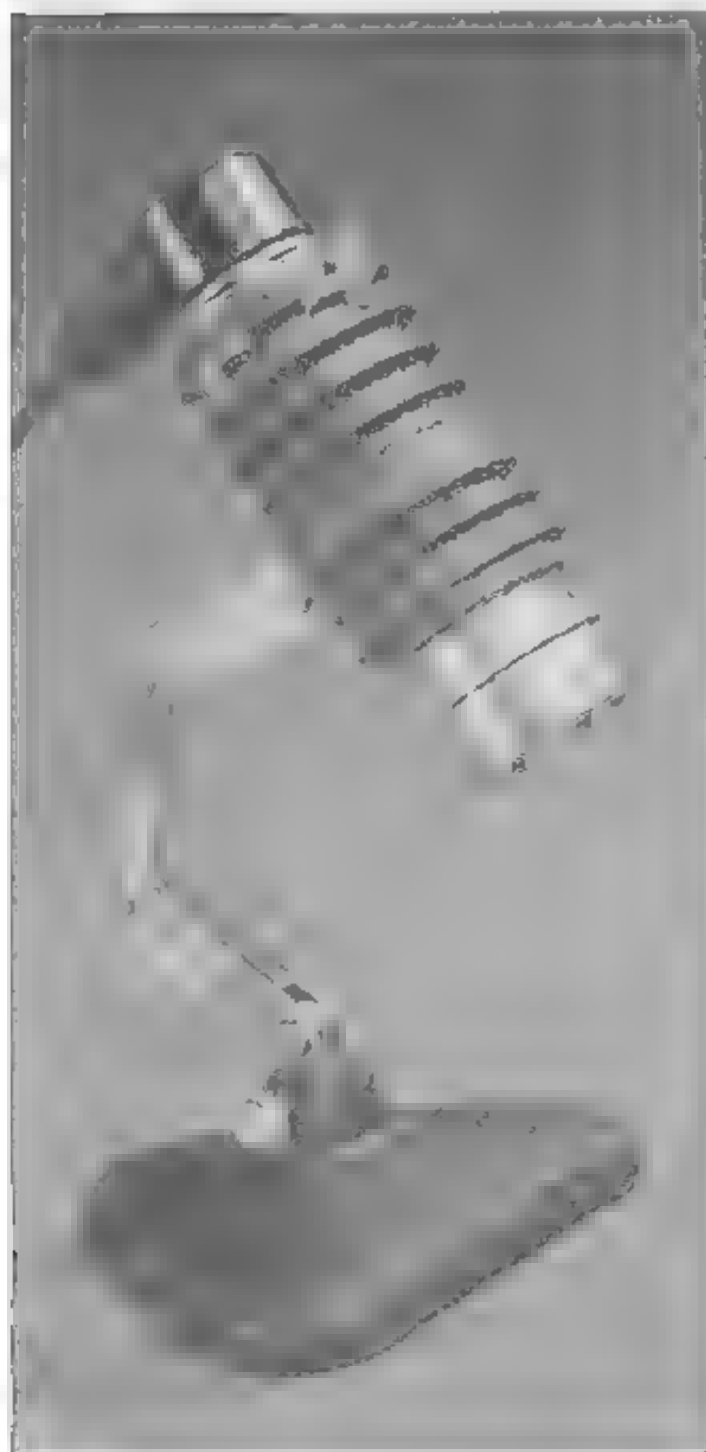
The same size filter is used in the substage of the Spencer microscopes as is used in the lamp. An iris diaphragm available for use on the substage, slips over the focusing mount in place of the filter holder and will hold any of the filters in position. The lamp is a brilliant source which may be focused from a sharp image of the filament to an evenly illuminated spot of light.

The 6.5 volt, 2.75 ampere bayonet base single filament type bulb may be easily changed. The voltage is controlled by a variable transformer.

No. 353 Lamp is mounted in a three-link jackknife support and cast iron triangular base. It may be removed from the base for mounting on the Spencer Stereoscopic Microscopes.

Spencer Universal Microscope Lamp No. 351 is supplied with an optical bench for attachment to non-objective microscopes. It is supplied without the base and links. But for the user who may wish these accessories, No. 349 is listed.

No. 356 Lamp is mounted on a rod six inches long to be used on any ring stand for illuminating scales, dials, and gages, and to provide spot illumination where required in laboratory use.









## Adjustable Laboratory Lamp

Adjustable Lamps Nos. 369 and 370 meet a wide range of laboratory uses. They may be used for all general microscope illumination, for dark field work, and for photomicrography.

Effective illumination is furnished by the combination of 100 watt bulb, silvered reflector, and effective system of condensing lenses. The size of the illuminated field is controlled by means of an iris diaphragm with graduations. The lamp is focused by adjustment of the slide unit containing the bulb and reflector.

The lamp is easily adjustable on its support both as to angle and height. The large, heavy base and upright holds the lamp house rigidly in adjustment.

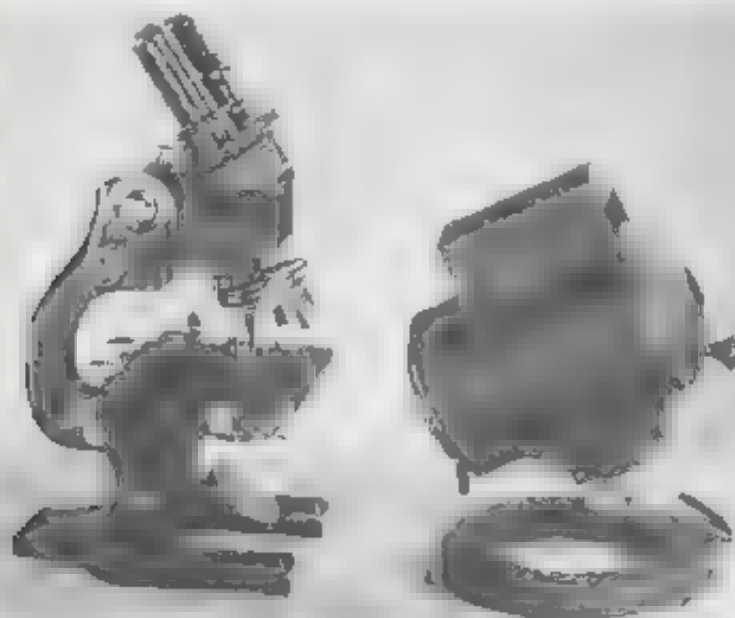
Heat is dissipated by the ventilated lamp house. A non-heat-conducting button at the back of the lamp house makes it easy for the operator to change the angle of the light while working.

The finish is a combination of enameled black enamel and chromium plating. A five-foot cord, having a switch between lamp and plug, is supplied. Regular equipment includes blue and ground glasses or Corning Daylite Glass, as ordered.

### Dimensions

Diameter of base, 6 $\frac{1}{2}$  inches. Length of lamp, 7 inches. Diameter of lamp, 4 $\frac{1}{4}$  inches. Diameter of aperture, 2 $\frac{1}{2}$  inches.

Cat. No.	Description	Price
369	Lamp, complete as described. 100 watt, 120 volt, Medium Base Bulb, and with one blue and one ground glass.	\$12.00
370	Lamp, complete as described with one Corning Daylite Glass.	\$12.00
369A	Same as 370A, but without iris diaphragm.	\$10.00
369B	Same as 369B, but without iris diaphragm.	\$10.00
369C	Ground glass, 2 $\frac{1}{2}$ inches diameter for use with Nos. 369 and 370 Lamps.	\$1.00
369D	Blue Glass Filter 2 $\frac{1}{2}$ inches diameter.	\$1.00
369E	Daylite Glass Filter 2 $\frac{1}{2}$ inches diameter.	\$1.00
369F	Filter and Water Cool Holder for use with Nos. 369 and 370 Lamps.	\$1.00
369G	Water Cool.	\$1.00
369H	Neutral Density Filter 3 $\frac{1}{2}$ x 5 inches, transmission 25%.	\$1.00
369I	Neutral Density Filter 2 $\frac{1}{2}$ x 4 inches, transmission 25%.	\$1.00
369J	Neutral Density Filter 1 $\frac{1}{2}$ x 3 inches, transmission 25%.	\$1.00
369K	100 watt, 120 volt, Medium Base Bulb.	\$1.00
369L	125 watt, 230 volt Medium Screw Base Bulb.	\$1.00





## Substage Lamps

The compactness and adaptability of this Bakelite Substage Lamp makes it particularly useful where a simple, portable lamp is required. It provides illumination for most work and does not produce excessive heat.

The lamp is designed for use either in an upright position directly in front of the microscope mirror, or, by removing the mirror, in a horizontal position under the microscope condenser.

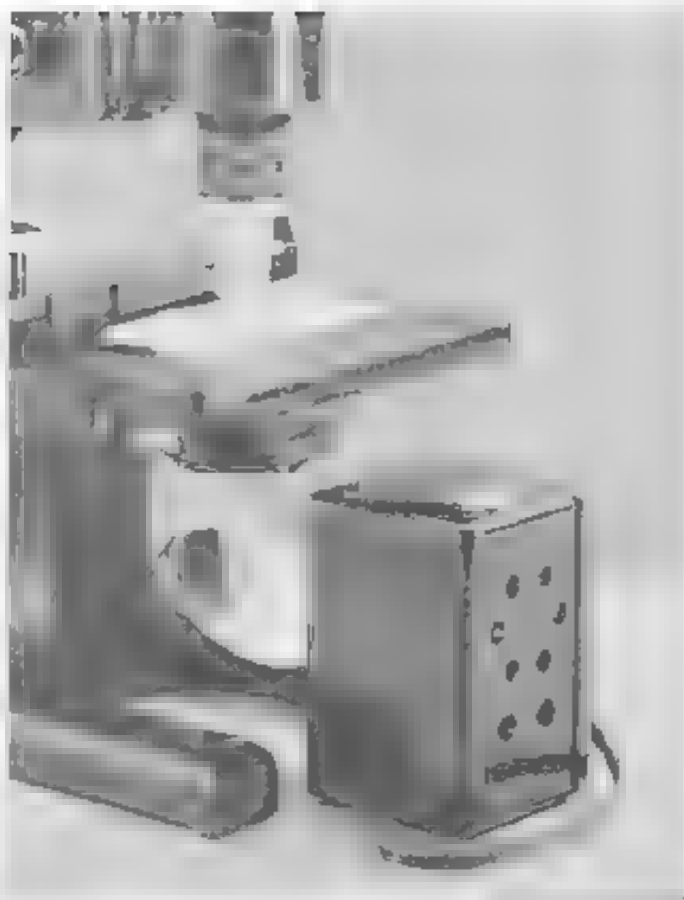
Constructed of tough Bakelite composition, it is capable of withstanding the continuous hard usage and minor accidents which occur in a laboratory. The smooth satin black finish is permanent and easily cleaned.

For changing bulbs, the lamp is readily separable into two sections. The 10 watt bulb furnished has a minimum replacement cost and may be connected with any 110-220 volt current. Regular equipment includes five feet of wire and either ground blade filter or Corning Davilite Glass filter, as ordered. A 15 watt bulb is also available and is recommended when the lamp is intended for use with a binocular microscope.

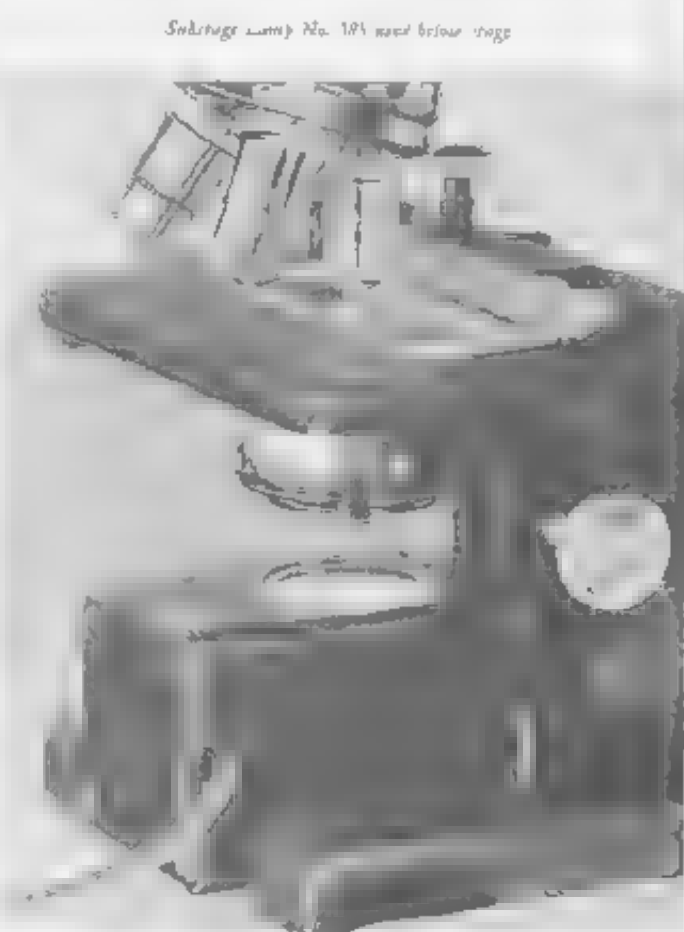
### Dimensions

Height, over all, 3 3/4 inches. Body 2 1/2 inches square. Diameter of aperture 1 1/2 inches.

No.	Description	Price
85C	Bakelite Substage Lamp with 10 watt 110-220 volt bulb and grounding wire. Complete with Condenser Base.	\$1.50
85	15 Watt 110-220 volt bulb.	.50



Substage Lamp No. 85C used in front of stage



Substage Lamp No. 18A used below stage



## Chalet Type Microscope Lamp

No. 361 Microscope Lamp is small and inexpensive, giving sufficient illumination for use with binocular microscopes with objectives of high magnifying power are used.

It is equipped with a 60 watt, 120 volt bulb. This bulb is standard and can be purchased at any electrical supply store.

The lamp is so well-ventilated that it can be handled comfortably at any time. The visor over the light opening is so arranged that, when the lamp is ten or twelve inches from the microscope, the eyes at the eyepiece are shaded.

A blue glass, ground on one side, is inserted in the aperture. A toggle switch is conveniently located near the base. Five feet of cord with plug are included.

### Dimensions

Height, over all, 7 inches. Body, 4 inches square. Aperture,  $2\frac{3}{4} \times 3\frac{1}{2}$  inches.

No.	Description	Price
361	Microscope Lamp with 60 watt, frosted, Type D medium screw base bulb, one blue glass in place of one side.	
362	Microscope Lamp with 60 watt, frosted, Type D medium screw base bulb, one blue ground glass in place of blue ground glass.	
363	60 watt, 120 volt, frosted, type D medium screw base bulb, MIC.	

*Chalet Type Microscope Lamp No. 361*





## Spencer Hematological Equipment

Hb-Meter

and

"Bright-Line"

Haemacytometer

For the purpose of determining the hemoglobin content of the blood, the Hb-Meter is used. It is a simple, accurate, and reliable instrument, and is the only one of its kind. It is used by the physician, the chemist, and the biologist. It is the only instrument of its kind that is used by the physician, the chemist, and the biologist. It is the only instrument of its kind that is used by the physician, the chemist, and the biologist.





*Haemocytometer No. 2401*

## Spencer "Bright-Line" Haemocytometer

The Spencer "Bright-Line" Haemocytometer is an instrument of many applications for yeast counts, for dust counts, for spinal, serous, or other body fluids. However, its chief use is for making red and white blood cell counts. For this work it has become a standard in most hospitals and clinical laboratories, an indispensable aid to many thousands of physicians and students.

The unique and most noticeable feature of the "Bright-Line" Counting Chamber is the sharp contrast of the bright lines against the darker metalized background.

In manufacturing the "Bright-Line" Chamber, metal is deposited on the glass counting areas in a very thin semitransparent layer, and the lines are etched through the metal. This metal coating is then fused into the glass.

### Superior Visibility Through Contrast

As a result of the use of this Haemocytometer, with less fatigue and eye-strain, better visibility is superior to that of other chambers. Under the microscope the lines appear white against the semitransparent darker background, with the contrast thrown into bold relief. The clarity of the lines depends mainly on this contrast. The triple dividing lines show clearly which cells lie within the counting area.

It is necessary to secure such an excellent placement of the illumination as is required with lines ruled in glass. There is no glare or fog upon the blood corpuscles or other particles in the field stand out



Spencer Bright-Line Counting Chamber

leary. It is not necessary to stop down the microscope, since the lines can be seen at any opening of the condenser diaphragm.

Green light is not necessary with this chamber, but if the user prefers light of this color, a green filter is available and may be used. (Catalog No. 307).

### Better Distribution of Corpuscles

Because of the differences in the surface tension characteristics of the metalized surface on the 'Bright-Line' Counting Chamber and the glass surface of the cover, the corpuscles are distributed evenly and the chamber is more easily filled. Even distribution of corpuscles is a recognized necessity for accurate counts. This fortunate characteristic of the Spencer Counting Chamber is a real aid in counting and increases its value.

### Precise Construction

The Bright-Line Counting Chamber is a single piece of glass with an H-shaped design forming two counting areas. It has raised supports to hold the cover glass the proper 0.1mm. distance above these areas and a concave indentation on the back. Great care is taken to grind the supports and polish the counting plateaus and cover glasses to correct size. The two cover glasses supplied with each chamber have plane polished surfaces to insure good contact with the cover glass supports.

The slight concavity on the underside, directly under the rulings, has been introduced so that scratches which would impair efficiency will not appear in this area of the lower surface of the chamber. This increases the useful life of the chamber.

Every counting chamber is tested by exacting scientific methods. The National



Spencer Bright-Line Counting Chamber

Bureau of Standards certification is available at a small additional charge.

The leatherette cases are plush-lined and provide space for the counting chamber, cover glasses and pipettes. There is sufficient space in all Spencer microscope cabinets or carrying cases for a Haemacytometer.

—

The Spencer 'Bright-Line' Haemacytometer is better—it must be seen under a microscope to actually realize fully its advantages.

### Standard Outfit Haemacytometer Listing

No.	Description
1452	Certified Red Pipette
1454	Certified White Pipette
1456	Red Pipette
1458	White Pipette
1461	Cover Glass 0.4 mm.
1483	Spencer Bright-Line Counting Chamber, with two 0.4 mm. cover glasses and pipettes certified.
1485	Same as 1483, but with chamber, cover glasses and pipettes certified.
1487	"Bright-Line" Counting Chamber, Double Improved Neubauer Ruling, without cover glasses.
1489	"Bright-Line" Counting Chamber, with two 0.4 mm. cover glasses.
1494	Same as 1482, but with chamber and cover glasses certified.
1500	Cardboard Case for Haemacytometer
307	Green glass, to fit microscope substage.



*The Spencer Hb-Meter No. 1000*

## Spencer Hb-Meter

For measuring the hemoglobin concentration of blood at the bedside or in the physician's office, the American Optical Company has designed a small hemoglobinometer in which a permanent glass wedge is used as a standard to make accurate colorimetric comparisons. No dilution or special reagents are necessary. Less than three minutes is needed to make this simple determination with a laboratory accuracy.

### Wedge for Comparison

A definite thickness of hemolyzed blood is compared with a glass wedge having similar absorption characteristics through a 10x eyepiece filter. The maximum absorption of hemoglobin occurs for visual light in the green band of the spectrum, and it is in this range that the comparison of hemolyzed blood and the glass wedge is made. Fortunately maximum visual sensitivity also occurs in the green range of the visible spectrum.

### Precise Glass Chamber

The double chamber, similar to the haematocritometer, has an H-shaped mount

which separates the two fields and spacing shoulders. A cover glass of equal thickness is held against the chamber by means of a metal clip. Two chamber plates may be used in place of a plate and cover in order to provide a double depth blood layer to increase the precision of measurement at very low hemoglobin levels.

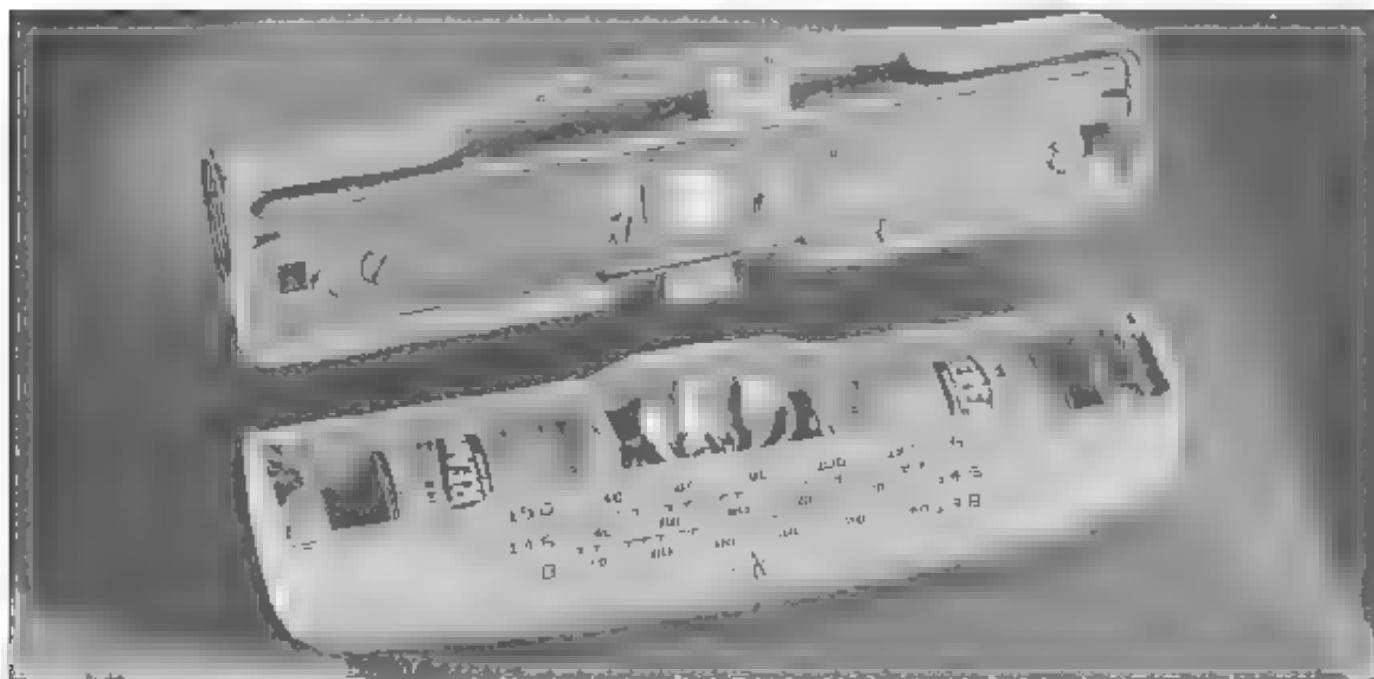
### Blood Quickly Hemolyzed

With the chamber offset so that one plate is exposed, a drop of blood is placed directly on it.

The drop of blood is then hemolyzed by agitating gently with a hemolysis applicator consisting of a small wooden stick tipped with a hemolyzing agent.

The hemolyzing process can be followed visually, and is complete when the blood loses its cloudy appearance and becomes a clear red solution. At this point the chamber is pushed completely into the clip, where it is held firmly against the cover glass as one unit. The complete clip is inserted in a slot in the instrument, and is now ready for use.

With laboratory samples of blood the hemolysis may preferably be made in a small test tube. The assembled chamber



*Spencer Hb-Meter disassembled to show position of batteries and bulb*

may then be filled with hemolyzed blood for comparison and each side of the aperture may be used successively without cleaning between two samples.

#### **Built-in Illumination**

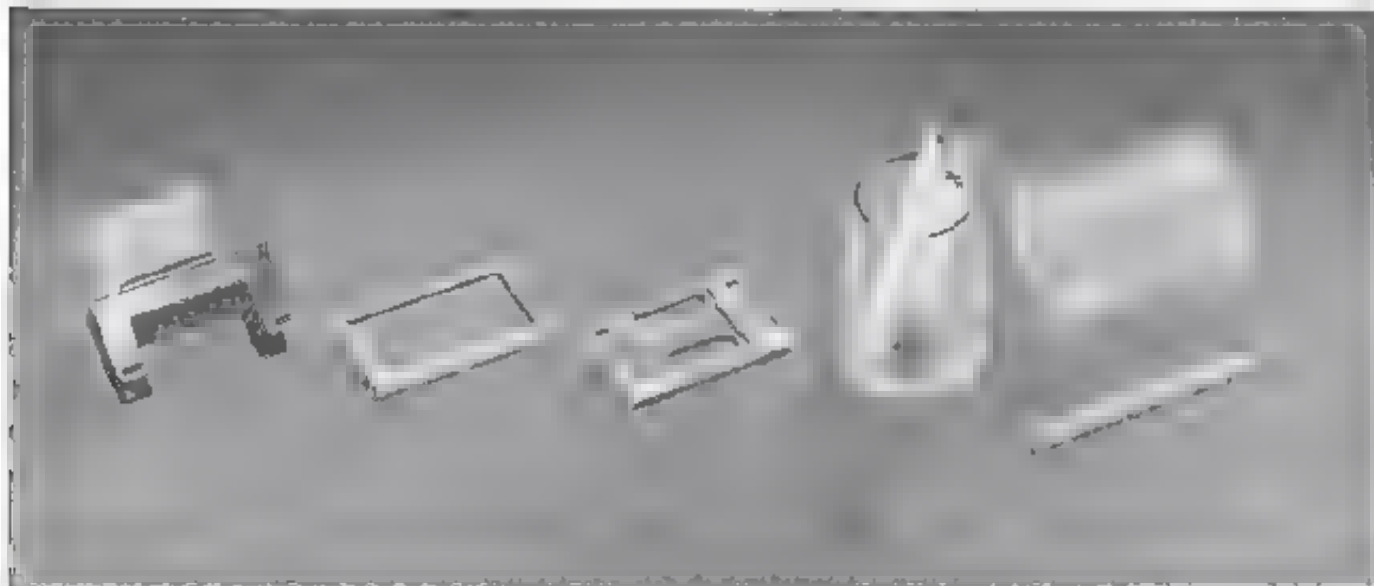
The Spencer Hb-Meter has its own built-in light source which can be operated either with batteries or from a 110-120 volt outlet by means of an accessory transformer or resistance. When the transformer is plugged in, the batteries are automatically cut out of the circuit. The lamp illuminates an aperture, one half of which is covered

by a glass wedge, and one half by the chamber and cover glass when in position. Light coming through each half of the aperture is directed by a combination right angle prism, and viewed through the

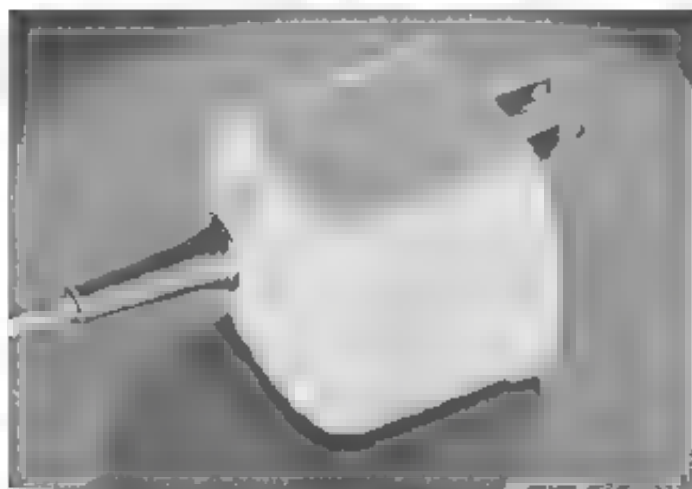
#### **Direct Reading Scales**

The glass comparison wedge is moved by a small metal knob extending through a slot in the side of the instrument. Once the readings have been matched, the hemoglobin concentration is read directly from the scale, using the index mark on the knob as an indicator. A single setting permits

*Left to right: Lamp, Cover Glass Chamber, Hemoglobin Aperture*





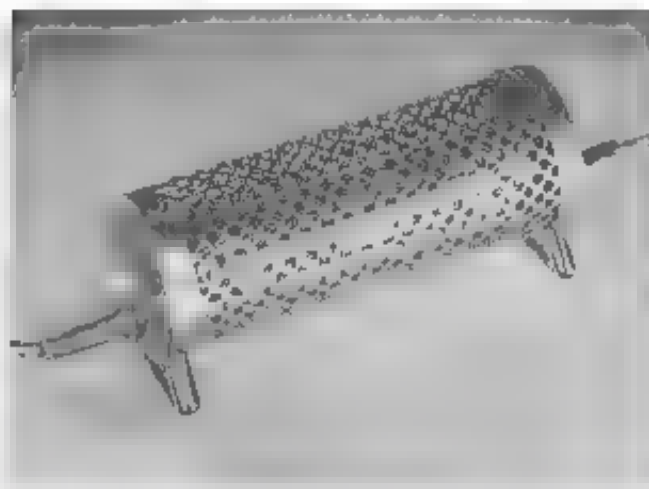


Transformer No. 1025

reading of hemoglobin in grams per 100 milliliters, or in terms of percentage based on 15.6, 14.5, or 13.8 grams per 100 milliliters equalling 100 per cent.

#### Benefits from New Construction

- 1 The Spencer Hb-Meter yields hemoglobin determinations comparable with those of the best laboratory methods.
- 2 Complete readings can be made in 2 or 3 minutes.
- 3 Easily carried in the hand, in the pocket or in the doctor's bag with his other instruments.
- 4 Matching of the green spot field is exact and contributes to precision. The comparison wedge of permanent glass has light absorption characteristics almost identical with those of hemoglobin for the wavelength range in which comparisons are made.
- 5 The use of hemolyzed blood eliminates errors due to turbidity so that the intensity variations of light passing through the blood samples are caused only by true absorption of the light by hemoglobin.



Resistor No. 1030

- 6 Inexpensive, disposable hemolysis applicators are the only supplies necessary.
- 7 The instrument is easy to clean and dry for subsequent use.

Cat. No.	Description	Price
1000	Hb-Meter outfit, consisting of Hb-Meter, complete with 1 bulb and 2 test series, in dust-proof pouch, accessories, carrying case, one clip, one chamber cover glass, and a set of 25 hemolytic applicators.	
1002	Chamber Clip	
1004	Carrying Case	
1005	Bulb, Model No. 213 (with pipette)	
1006	Battery, standard size 6 flash light	
1010	Accessory Case complete	
1013	Complete Glass Chamber, consisting of clip, chamber cover glass and chamber	
1025	Transformer, 50-60 c.c.c. for adapting Hb-Meter to 115 volt A.C. outlet	
	Hemo. test Applicators, 4 vials of 25 each in box	



# Spencer Microtomes

From the early cutting engines to the fine precision microtomes of today, many ingenious instruments have been developed to cut thin sections for microscopic investigation. Several outstanding designs were refined and improved by the engineering department. Numerous convenience features were added. Today Spencer microtomes are recognized throughout the world as the standard instruments for fine work.

The various Spencer microtomes are described on the following pages:

**ROTARY MICROTOMES** are the most convenient for cutting serial sections from paraffin embedded specimens up to 1½ inches.

**SLIDING MICROTOMES** will accommodate larger specimens than rotary microtomes. They are used to cut materials embedded in celloidin, frozen and hard materials as well as those in paraffin.

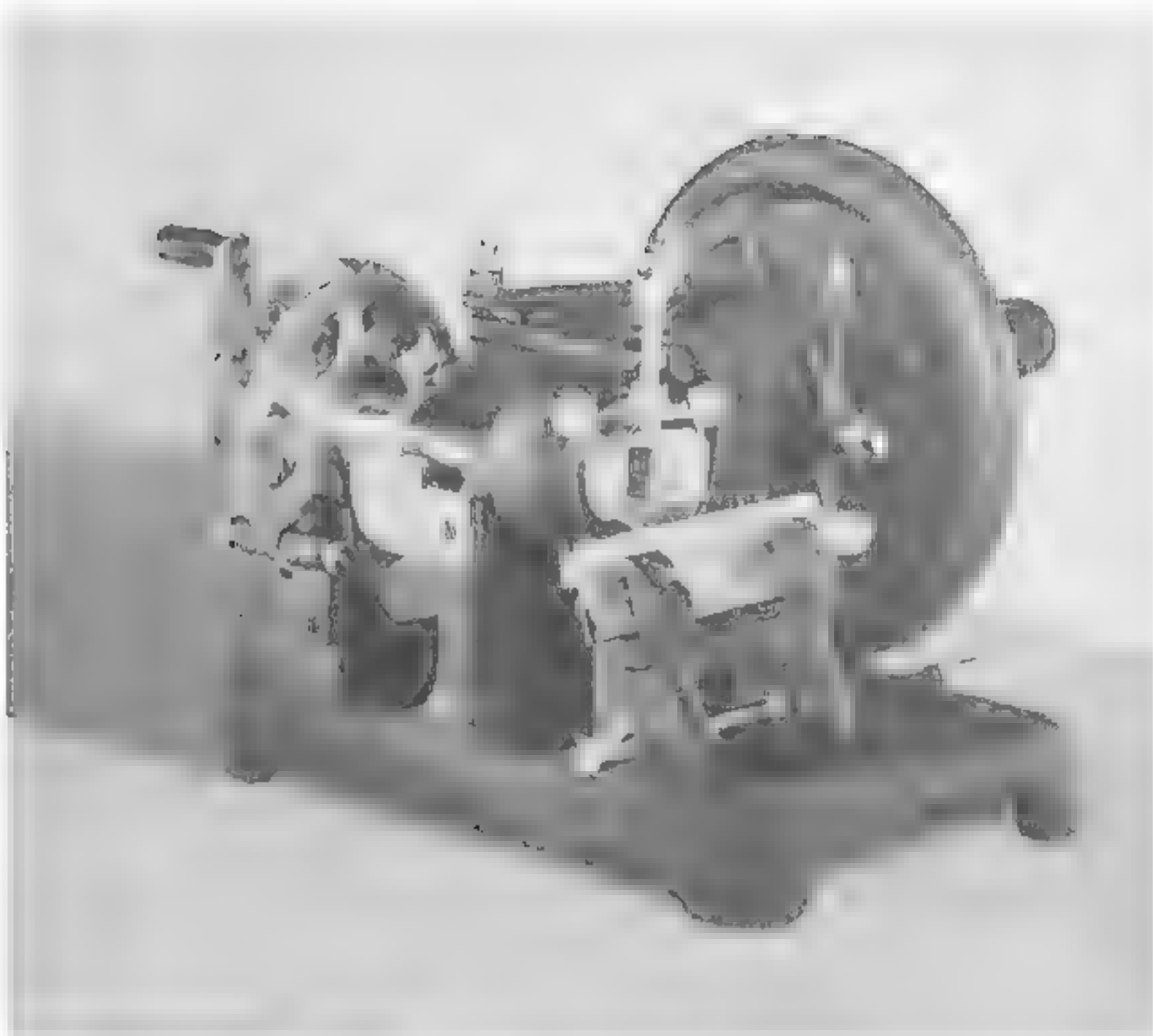
**AUTOMATIC CLINICAL MICROTOMES** are useful where speed in examining frozen sections is important.

They may be used to cut specimens in paraffin and celloidin.

**TABLET MICROTOMES** are the demonstration of the precision microtome in the class room for preparing plant sections for class use and for occasional use not requiring a complete instrument.

*The Effective Use and Proper Care of the Microtome*, an instructive booklet written by Oscar W. Richards, Ph.D., is available from the factory or any branch office. A host of 75 representatives and technicians are ready at all times to answer questions and help solve your problems.





Model No. 820 Rotary Engine

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100



## No. 810 Rotary Microtome

Those who desire the convenience of a rotary microtome at a moderate cost will choose this model. It is sturdy, smooth in operation and designed so that it can be stopped at any position.

### Feed Mechanism

A feature of all Spencer Rotary Microtomes which protects the feed mechanism from shock is the complete independence of this mechanism from the vertical movement of the object. A spring holds the object block under tension in positive contact with the feed screw, but the block is free to move up and down as the crank is turned. The substantial feed screw is attached to a ratchet wheel which, turning in the notches, feeds on the downward stroke and is released returning free of the teeth on the upward stroke.

The total excursion of the feed is 22mm. Sections can be cut from two to forty microns in thickness. A crank at the end of the feed screw provides a convenient means of adjusting the object to the knife and of returning the object clamp to the beginning of the feed screw when starting a new series of sections. When the object clamp reaches the extreme forward position, the feed mechanism automatically ceases to work.

### Object Clamp

The ball and flange type object clamp has three adjustment screws to hold the object rigidly in position and provide the

means for orienting it to any desired position which may be changed in any plane without interfering with that already obtained in another plane. The entire clamp may be rotated on its axis if any one of the screws is loosened. Blocks 32mm wide and 17mm high may be used. By removing an adapter, a block 27mm high is accommodated. Three object discs,  $\frac{7}{8}$ ",  $1\frac{1}{8}$ " and  $1\frac{3}{8}$ " in diameter are supplied.

### Knife Holder

The holder is simple, rigid and easily adjusted to and from the object. The angle of the cutting edge is adjustable through a small arc.

### Knife

Spencer No. 940 knife, 110mm long and of the highest quality steel, is supplied complete with No. 960 back and No. 955 handle for interchange.

### Finish and Case

The finish is durable black alcohol proof enamel and chromium plating. The instrument is shipped in a suitable wooden case.

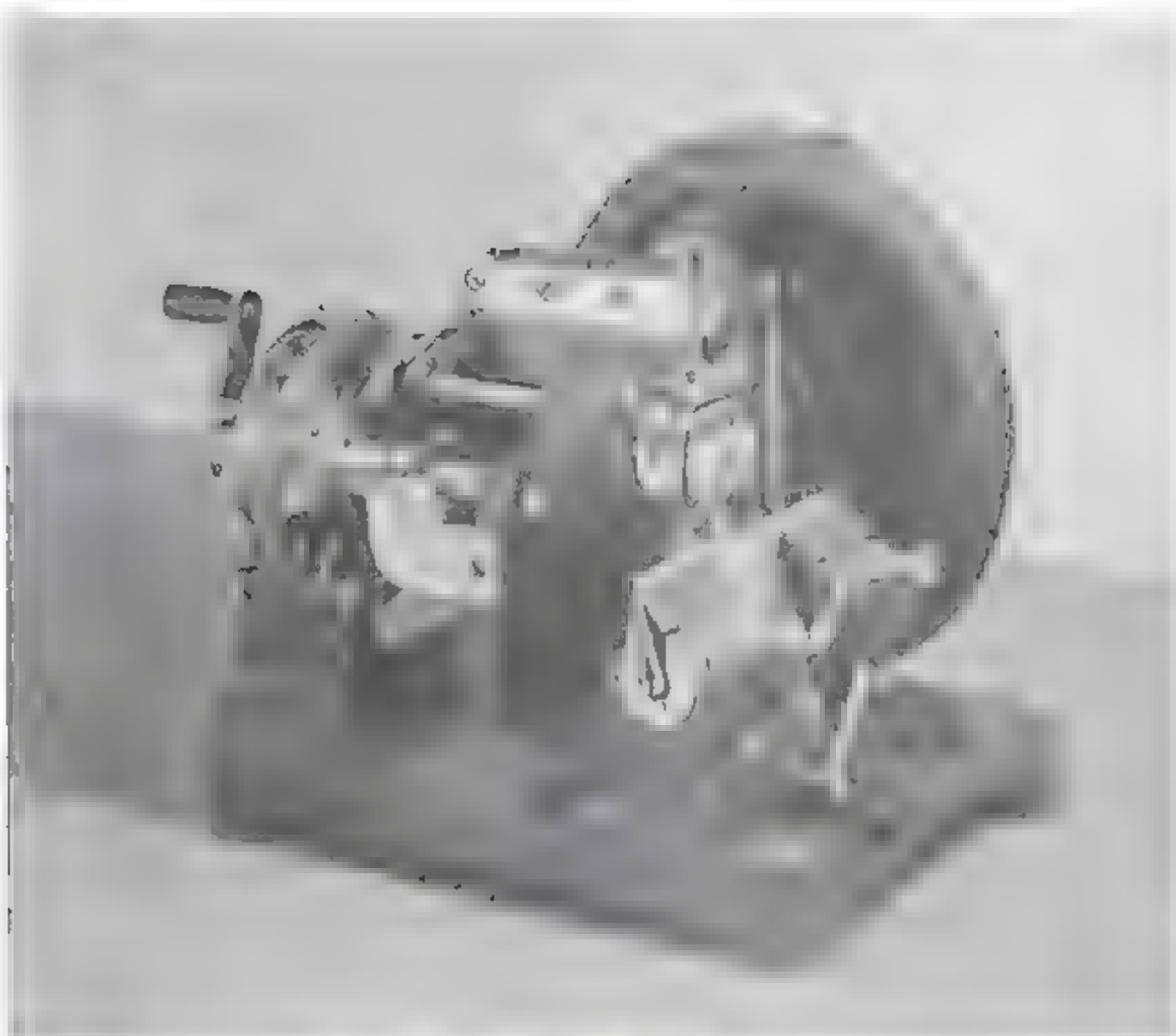
### Size and Weight

Length 93 $\frac{1}{4}$ "      Height 8"  
Width 8"      Net Weight 31 lbs.

Cat. No.	Description	Price
810	Spencer Rotary Microtome with No. 940 knife, 960 back, 955 handle, three object discs and 468 cut glass	

*The feed mechanism of Spencer Rotary Microtomes is independent from the vertical movement of the object.*



[illegible]
$$F = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix}, \quad \mathbf{f} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \quad \mathbf{x} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \quad \mathbf{v} = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}.$$



## No. 815 Rotary Microtome

Catalog No. 815 is of medium size and weight and provides extra smooth action as well as an adaptable type of knife holder.

### Feed Mechanism

The feed mechanism is independent of the vertical movement of the object. The threads of the large feed screw are ground and lapped into the feed screw nut. The ratchet wheel, actuated by a pawl working in the notches, is attached to the feed screw and forward movement of the object block is accomplished only after the specimen has passed upward beyond the knife. The pawl is automatically reset from the teeth of the ratchet wheel on the downward or cutting stroke.

Total excursion of the feed is 21mm. Sections can be cut from two to forty microns in thickness. A crank at the end of the feed screw provides a convenient means of adjusting the object to the knife and of returning the object clamp to the position necessary for starting a new series of sections. When the object clamp reaches the extreme forward position, the feed mechanism automatically ceases to work.

### Object Clamp

The ball and flange type object clamp is used to hold the object rigidly in position and provide the means for orienting it to any desired position which can be changed in any plane without interfering with that already obtained in another plane. The entire clamp may be rotated on its axis. Easy one of the screws is loosened. For the usual work, blocks 32mm wide and 17mm high can be used. By removing an adapter a block 27mm high can be accommodated. Three object discs, 7 1/8", 1 1/8" and 1 1/2" in diameter are supplied.

### Knife Holder

Double width clamps each support the knife along 1 1/2" at the cutting edge and provide for tilting the knife.

### Knife

Spencer No. 942 knife, 120mm long and of the highest quality steel is supplied complete with No. 961 back and No. 955 handle for sharpening.

### Finish and Case

The finish is durable black alcohol-proof enamel and chromium plating. The instrument is shipped in a strong wood case.

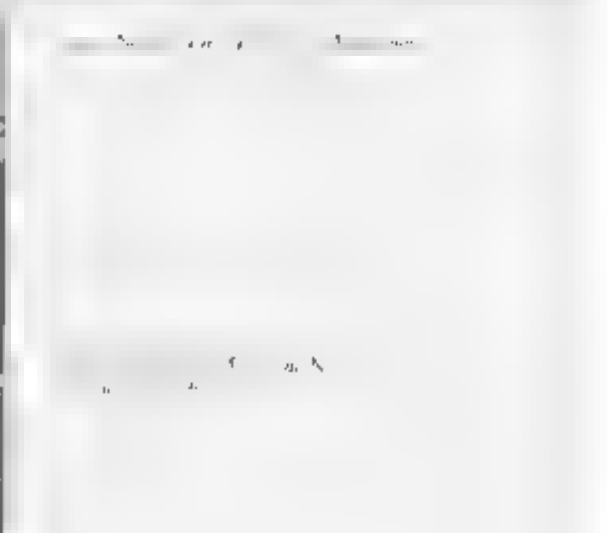
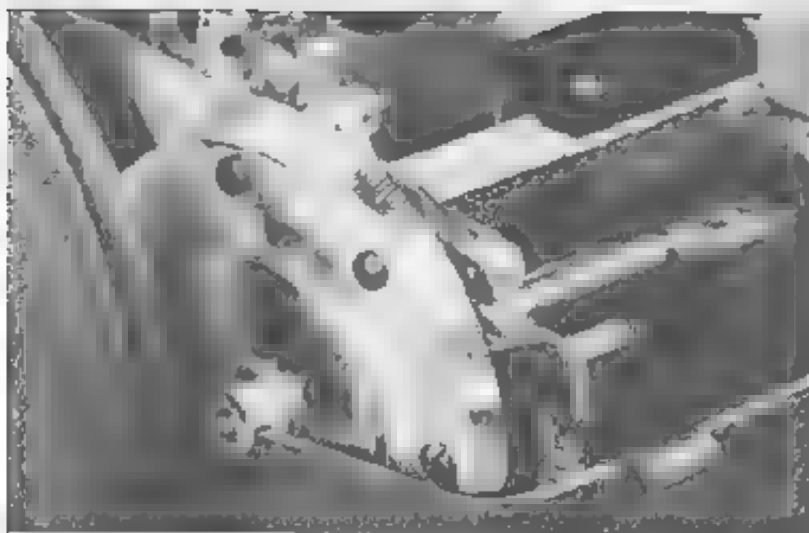
### Size and Weight

Length 9 3/4"      Height 8 1/2"  
Width 8 1/2"      Net weight 14 1/2 lbs.

See Rotary Microtome with No. 942 knife, 961 back, 955 handle, 969 disc and 969 adapter. Also see No. 627 knife holder on No. 815 page.

Slideways in Spencer No. 815 Microtome indicate the position of object movement.







## No. 820 Precision Rotary Microtome

The Spencer Precision Rotary Microtome No. 820 is designed for the most accurate serial sectioning. It is especially adapted for cutting sections at the desired angle for cutting serial sections of any material with uniformity. There are probably more of these instruments in laboratories of all types of microtome in laboratory use today. Their success arises from sound engineering, exactness in specification of the materials used, and from control throughout the manufacturing process. This instrument is rigid and massive in construction, yet precise and convenient to use.

### Feed Mechanism

The feed mechanism—a very important element in a microtome—is entirely independent of the vertical movement of the object. It is built rigidly into the base casting. The extra large feed screw is carefully ground and lapped into the feed mechanism. The ratchet wheel is attached to the feed screw, and notched so that specimens may be cut any desired thickness from one to fifty microns. A pawl, working in the teeth, feeds on the forward stroke and is released, returning free of the teeth (without any wear) on the return stroke. The force of the feed screw is transmitted to the specimen through an inclined plane. The setting is accomplished by turning a knurled button at the back of the case. The number representing the feed thickness appears opposite the indicator at the small opening in the side of the case near the balance wheel. A new positive locking mechanism features the exact setting on the indicator so that even slight errors in setting are now impossible.

The total excursion of the feed mechanism allows a sufficient range for cutting long series without resetting the knife and the feed mechanism.

A crank at the end of the feed screw provides a convenient means of adjusting the object to the knife and of returning the object clamp to the beginning of the feed when starting a new series of sections. When the object clamp reaches the extreme forward position, the feed mechanism automatically ceases to work.

### Object Clamp

The object clamp is the standard ball and flange type which has been such a feature on Spencer microtomes.

Screws hold the object in position and provide the means for orienting it to the desired position. The entire clamp may be rotated on its axis if any one of the screws is loosened.

The object clamp is large enough to take a block 32mm wide and 17mm high with an adapter that may be removed to provide for a possible height of 17mm. Three object disks are regularly supplied.

The up-and-down stroke of the object clamp is 2 inches, which permits the cutting of large sections and gives sufficient stroke for cutting calcareous material. The clamp is held at its upper limit, for orienting or trimming the block, by a lever under the balance wheel.

### Knife Holder

No. 820 Microtome is equipped with a rigid knife holder. There are two wide clamps each supporting the knife along 1½ inches of the edge. The knife may be clamped through an exceptionally wide range of cutting angles. Adjusting screws provide for knives of different widths. The whole knife support is adjustable to and from the object, and is clamped easily and conveniently in any position by a lever operating with an eccentric cam.

### Knife

Spencer No. 942 knife, 120mm long and of the highest quality steel is supplied complete with No. 961 back and No. 955 handle for sharpening.

*The amount of feed at points of impact is the rate of cut.*







*Slide camera support the knife at the preferred cutting angle.*

### Case

The feed mechanism and other moving parts are covered to protect them from dust. The attractive cover of the instrument is hinged to the base casting, permitting easy access to the mechanism.

### Finish and Cabinet

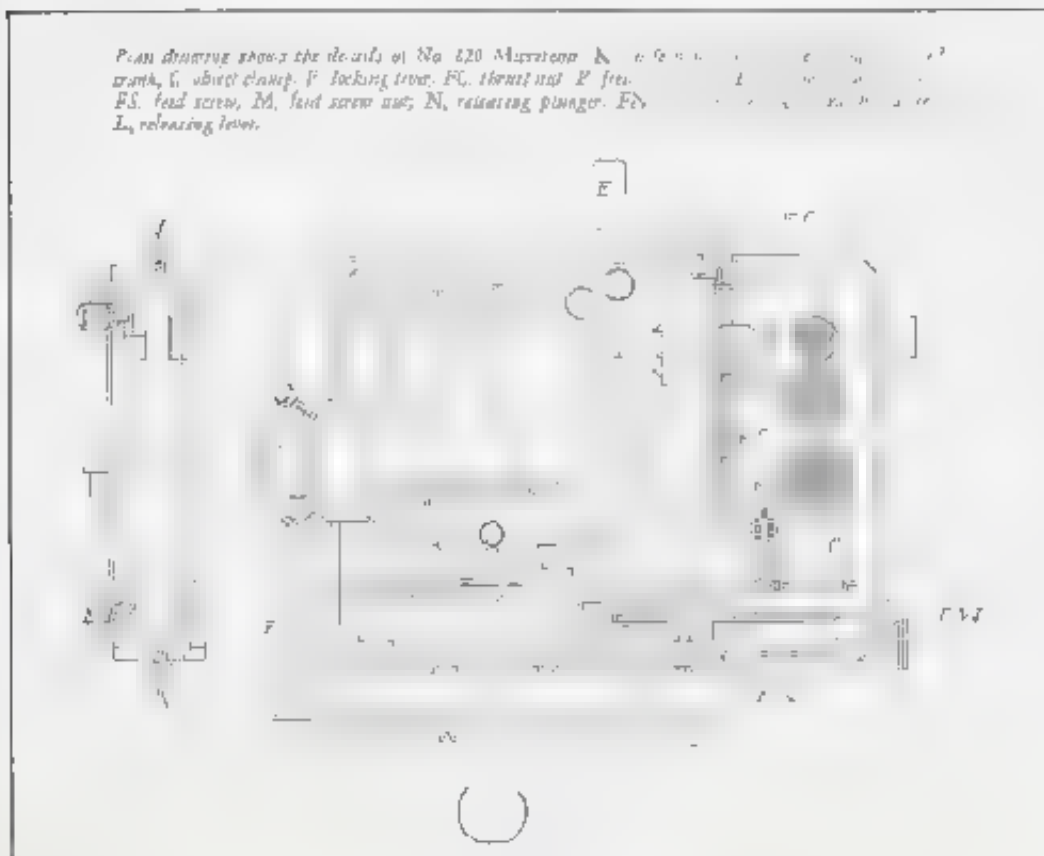
The finish is durable black alcohol proof enamel, and chromium plating. The instrument is shipped in a substantial oak cabinet having a hinged door with a latch.

### Size and Weight

Length 14"      Height 8 $\frac{3}{4}$ "  
Width 8 $\frac{5}{8}$ "      Net Weight 60 lbs

Cat. No.	Description	Price
1	Spencer Precision Rotary Microtome with No. 94" knife, 981 back, 953 handle, three object chucks and 969 oil	2.50

*Plan drawing shows the details of No. 620 Microtome. A, 1/2" x 1/2" x 1/2" block; C, object clamp; P, locking lever; FC, front nut; P, feed screw; BS, feed screw; BS, feed screw nut; N, rotating pinion; FD, releasing lever.*



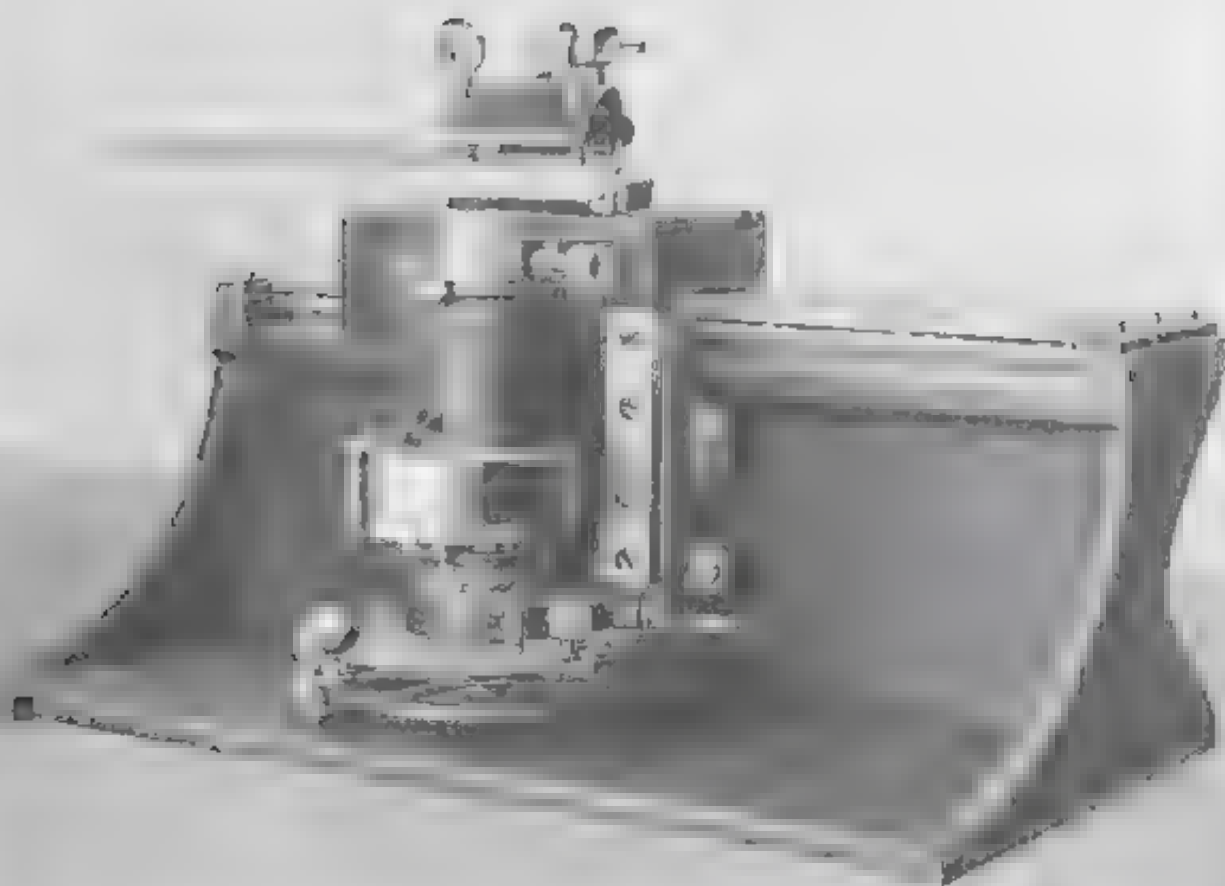


120 Microtome made blinged case open to show the independent feed mechanism and sturdy slides.

### Rotary Microtomes

Model Number	Feed Mechanism	Feed of Feed (mm)	Clamp Number	Holder	Clamp Dimensions	Approx. Weight in Pounds
B10	2 manual	22 mm	Ba 940 knife and 960 back Flange 975 handle	Simple clamp cutting angle adjustable through small angle	2 1/4" long 3" wide 8" high	32
B15	2 manual	22 mm	Ba 942 knife and 961 back Flange 975 handle	Simple clamp cutting angle adjustable through small angle	2 1/4" long 3" wide 8" high	10
B20	1 manual	28 mm	Ba1 942 knife and 961 back Flange 975 handle	Double supporting clamp with cutting angle adjustable through wide angle	4" long 8 1/2" wide 8 1/2" high	60

Three object discs, 7/8, 1 1/2 and 1 3/4 inches in diameter are supplied on all rotary microtomes.  
 All rotary microtomes have an object clamp that will accommodate object blocks up to 12x27 mm.



1478



## No. 850 Sliding Microtome

When a wide variety of assignments are added the cutting of frozen preparations, celloidin and hard specimens is a key to reach the laboratory, a Spencer sliding microtome is preferred. Rigid construction, freedom from play and smooth action are essential in obtaining uniform results. The two most important considerations are the knife slide and the feed mechanism. Success depends largely upon the precision of these two mechanisms.

### Knife Slide

Years of experience and continuous development account for the excellent slides on these Spencer microtomes, recognized by the following features:

The knife block, 3" wide and  $3\frac{1}{4}$ " long to which the knife is clamped, slides on a horizontal surface at the top of the main casting and is held in contact with adjusted opposing bearings on the under side. The knife block is supported on different surfaces (15 square inches) and is held in contact with the main casting by a series of springs.

### Feed Mechanism

The specimen, fed either automatically or by hand, moves upward at the end of each return stroke of the knife. Total excursion of the feed is 30mm., the specimen moving in units of two microns up to a maximum thickness of forty microns. An indicator shows the amount of feed in microns. Freeze alcohol or water used in cutting slides into a removable drip pan in the feed mechanism. A crank, geared to the large  $\frac{1}{2}$ " diameter feed screw, provides a rapid means of moving the object up or away from the cutting position.

To maintain the accuracy of the feed, the bearings supporting the object clamp are heavy, wide and carefully fitted.

### Object Clamp

The half and large type object clamp has three adjusting screws for orienting the specimen to any desired angle. By adjusting any one of the screws the object clamp may be rotated on its axis. An object disc  $1\frac{1}{2}$ " in diameter is supplied.

### Knife Holder

Many different kinds of material may be handled since provision has been made for setting the knife at any angle to the direction of travel as well as tilted to any desirable cutting angle. A scale indicates the angle of tilt of the knife. Adjusting screws facilitate the use of knives of different widths.

### Knife

Spencer No. 945 knife, 185mm. long and of the highest quality steel is supplied complete with No. 962 back and No. 955 handle.

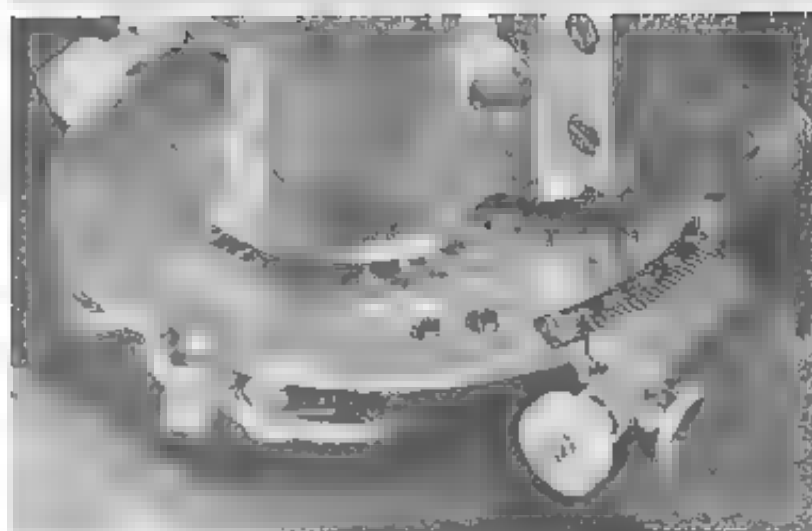
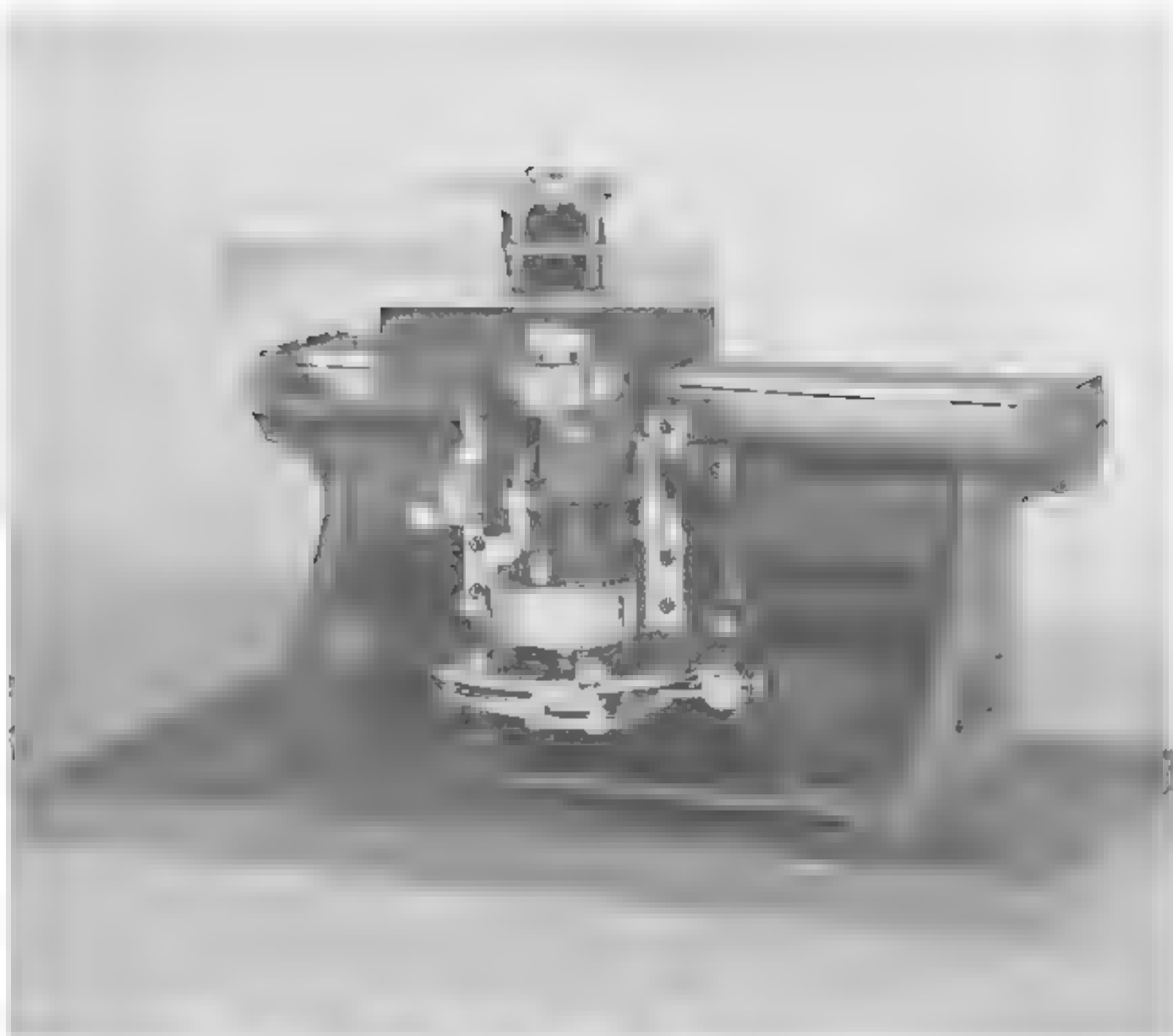
### Finish and Cabinet

The microtome is finished in a durable black alcohol-proof enamel and chromium plating. It is shipped in a substantial oak cabinet with handles and a hinged door with latch.

### Size and Weight

Length 14  $\frac{1}{2}$ "      Height 11"  
Width 10  $\frac{1}{4}$ "      Net Weight 63 lbs

Cat. No.	Desc.
850	Spencer Sliding Microtome with No. 945 knife clamp, 945 handle, 962 back, 955 handle, one object disc, 1-1/2" diameter and 969 cut cut



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† *See* also *Journal of Management Education* 20(1), 1996.

11      41      111



## No. 860 Precision Sliding Microtome

The Spencer heavy duty sliding microtome is ideal for cutting large or unusually rough specimens. Extra overall size and weight make it capable of many assignments, such as cutting celloidin, paraffin embedded, frozen or hard preparations. No. 860 is the most useful microtome for the busy hospital or research laboratory.

### Knife Slide

The knife block,  $3\frac{1}{2}$ " wide and 6" long, to which the knife is clamped, slides on a horizontal surface at the top of the main casting. It is held in contact with the 16" long top surface by carefully adjusted opposing bearings on the under side. The oil contact between these different bearing surfaces (20 square inches) insures an exceptionally easy action.

### Feed Mechanism

The specimen may be fed automatically, and moves upward at the end of each return stroke of the knife. Total excursion of the feed is 42mm, the specimen moving in units of 2 microns up to a maximum thickness of 40 microns. An indicator determines the specimen thickness. Excess alcohol or water used in cutting drains into a removable drip pan provided for the protection of the feed mechanism. A crank, geared to the  $\frac{3}{8}$ " diameter feed screw, provides a rapid means of moving the object up to or away from the cutting point.

### Object Clamp

The small and large type object clamp has three adjusting screws for orienting the specimen to any desired angle. By loosening any one of the screws the entire clamp may be rotated on its axis. An object disk  $1\frac{1}{2}$ " in diameter is supplied.

### Feed Screw

The support for the object clamp is a large casting with wide, carefully fitted side bearings, providing rigidity and freedom from lost motion.

### Knife Holder

Provision has been made for setting the knife at any angle to the direction of travel as well as to any desirable cutting angle. A scale indicates the angle of tilt of the knife. Adjusting screws facilitate the use of knives of different widths.

Catalog No. 862 Adjustable Knife Holder, which supports the knife at both ends, is available at extra cost. It is recommended for cutting large specimens. It is described and listed with the microtome accessories.

### Knife

Spencer No. 950 Knife 250mm long and of the highest quality steel is supplied complete with No. 963 back and No. 957 handle.

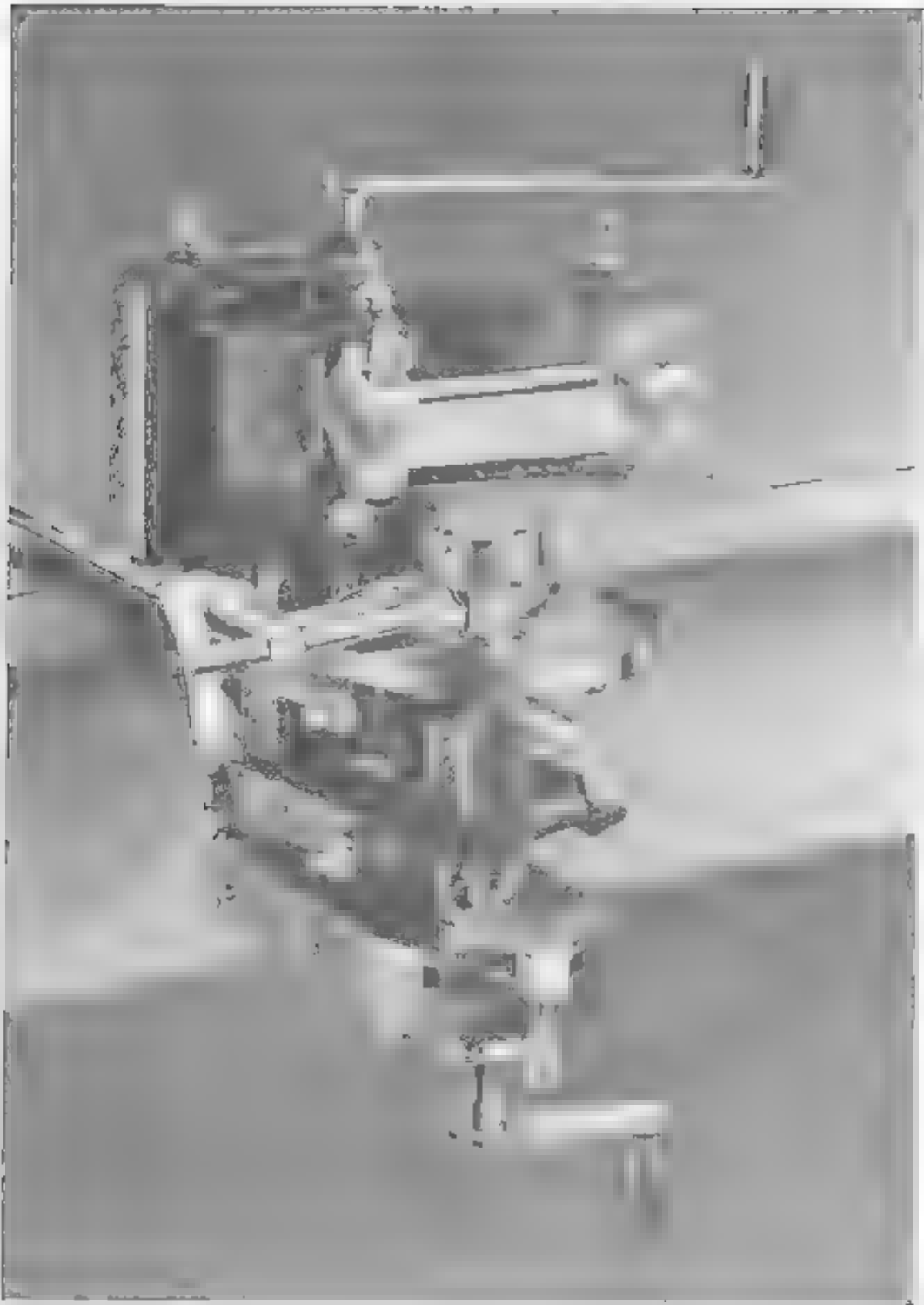
### Finish and Cabinet

The finish is durable black alcohol proof enamel and chromium plating. The microtome is mounted permanently on a heavy wood base and is shipped in a substantial oak cabinet with handles and a hinged door with latch.

### Size and Weight

Length 17 $\frac{1}{2}$ "	Height 14 $\frac{1}{2}$ "
Width 11"	Weight 83 lbs.

Cat. No.	Description	Price
860	Spencer Precision Sliding Microtome with No. 862 knife clamp, 950 knife, 963 back, 957 handle, one object disk, $\frac{3}{8}$ " diameter and 969 oil.	



*Abv. № 881 Армовский Клипп. Механизм с полностью оборудованной системой привода*



## No. 888 Automatic Clinical Microtome

Designed to fill a definite need in hospitals where speed is important to successful surgery, the No. 888 Microtome makes it possible to cut frozen tissue a most as fast as it can be mounted in less than 1 1/2 minutes from the time the tissue is placed on the freezing plate.

### Feed Mechanism

The feed mechanism consists of a ratchet which moves the specimen automatically with each stroke of the handle. It can be disengaged by setting at 0, or set to cut specimens from 5 microns to 50 microns in thickness. The graduations are in 5 micron intervals.

### Freezer or Object Holder

The carbon dioxide freezing chamber and copper cooling tube, supplied as standard equipment, can be removed easily. For cutting paraffin or celloid, specimens a standard 1 1/2" object disc is provided. A large air pan, adaptable for freezing, is mounted beneath the object

### Knife Holder

Two non-rotating arms hold the knife in such a way that the slicing cut utilizes much of the cutting edge. When the handle is turned, the knife describes a pattern corresponding to the double movement of free-hand sectioning.

The swinging arms and knife holder are sufficiently rigid to avoid deformation of the knife, thus assuring uniformity of thickness.

### Table Clamp

The main supporting frame has a heavy clamp at the back by which the microtome can be fastened securely to the laboratory table.

### Knife

Spencer No. 940 knife, 11mm. long and of the highest quality steel, is supplied complete with No. 960 back and No. 955 handle for sharpening.

### Finish

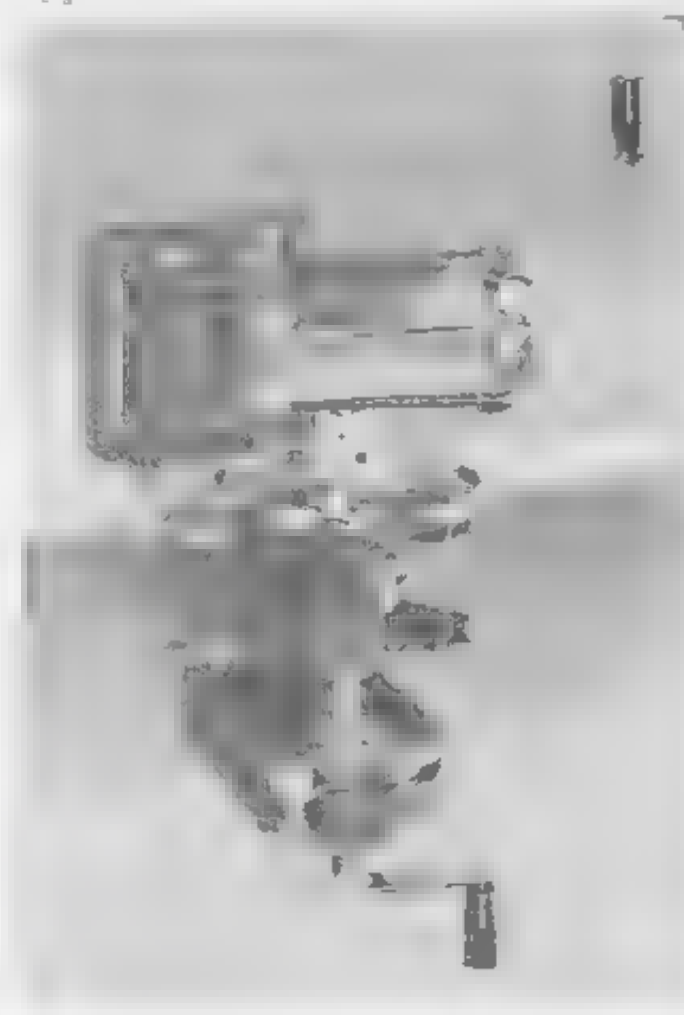
The finish is durable black alcohol proof enamel and chromium plating.

## No. 880 Automatic Clinical Microtome

This microtome is exactly the same as the No. 888 except that it is not equipped with the freezing attachment. The usual paraffin or celloid sectioning is possible and, when necessary, a freezing chamber can be attached easily.

Spencer No.	Description	Price
880	Spencer Automatic Clinical Microtome with No. 940 knife, 960 back and 955 handle and with one object disc.	
885	Object clamp for paraffin and celloid.	
888	Spencer Automatic Clinical Microtome with No. 940 knife, 960 back and 955 handle with one 1 1/2" object disc and 956 freezing attachment for CO <sub>2</sub> .	

No. 880 Microtome is the same as 888 but does not have the freezing attachment.







## No. 900 Table Microtome

When speed is not essential and a hand operated feed is sufficient, No. 900 Table Microtome will be satisfactory. It is widely used in schools for section cutting in elementary biology and is adequate for much plant material. Using a razor or a microtome knife with handle attached, one can cut sections from 5 to 500 microns thick.

### Feed

Movement on the paraffinograph principle is regulated by a micrometer screw with graduated disc and index plate by which any desired thickness of sections may be cut in steps of 5 microns.

### Object Holder

Specimens up to  $1\frac{1}{10}$ " can be handled

### Knife Slide

Horizontal glass plates  $3\frac{1}{8}$ " long by  $\frac{1}{16}$ " wide provide traveling ways upon which the knife slides so that the knife

will be supported for more than  $\frac{1}{16}$ " of the cut. A sliding support is also provided.

### Table Clamp

The main frame has a heavy clamp at the back by which the microtome can be fastened securely to the laboratory table.

### Knife

This microtome is supplied without knife. Either a section razor (straight edge) or a Spencer knife with back and handle may be used.

Cut	
900	Spencer Table Microtome without knife
900	Spencer Table Microtome without knife but with 900 freezing attachment for CO <sub>2</sub>

Fig. 1 The No. 900 Table Microtome





## Spencer Microtome Knives



*Spencer Knife Back and Handle*

Most of this space is devoted to the mechanical construction of microtomes, yet the finest microtome is useless without a good knife, properly sharpened and set at the right angle.

The Company has fully appreciated its responsibility to produce knives of the highest quality and has carried on continued research and experimentation. This theoretical work has supplemented the experience of manufacturing and sharpening many thousands of microtome knives since the start of the present century.

Today technical control throughout the manufacturing processes assures uniform

quality. Steel is heated to the proper temperature—quenched to obtain the maximum hardness—partially drawn to bring out toughening characteristics—tested for hardness and micro structure, then finish-ground and honed for critical use in the

microtome. The carbide process is specified for Spencer microtome knives to provide myriads of carbide particles (as hard as diamonds), embedded in the matrix of steel, to give the knife the maximum cutting efficiency.

Spencer knives are broad and heavy. They are sufficiently rigid to maintain their hard specifications.

### SPENCER MICROTOME KNIVES

Length in mm	Type	For Use with Microtome	Price
10	Hollow Ground	800 890 980	
20		815 925	
120		820 930	
185		830 940	
45	Hollow Ground	840 950	
250	Hollow Ground		
350			

Knives may be ordered by length or by type. (See chart below.)

### SPENCER MICROTOME KNIFE PACKS

Case No.	Length in mm	For Use with Knife	Price
960	110	941	
961	120	942 943	
962	185	944 945	
963	230	946 947	

### SPENCER MICROTOME KNIFE HANDLES

Case No.	For Use with Knife	Price
948	943 942 943 945 946	
	940 941	



## Sharpening Microtome Knives

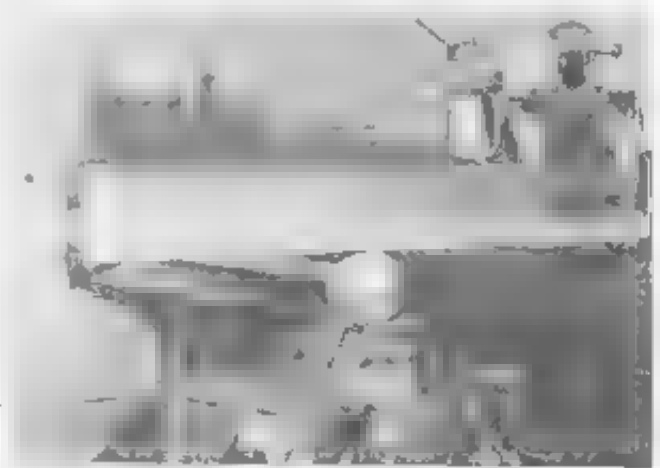
Special machinery has been developed for sharpening microtome knives and laboratory methods have been set up for testing them. All new knives are put into their original excellent condition with this method and it is just as useful for re-sharpening.

No.	Description	Price
40	20 mm knife	
44-45	40 mm knife	
44-46	85 mm knife	

## Knife Holders

Spencer Knife Holders prevent deflection of the knives, even with very tough materials. The wide clamps of the No. 827 hold the knife rigid at the edge. For the larger knives on the sliding microtome the No. 862 supports both ends.

No.	Description	Price
827	Spencer Standard Knife Holder regularly supplied on No. 820 Microtome can also be supplied for No. 821	
862	Spencer Standard Knife Holder regularly supplied on Nos. 830 and 861	
862	Spencer Adjustable Knife Holder regularly supplied on Nos. 830 and 861	



## Razor Blade Holder

The Spencer Holder No. 966 for safety razor blades can be used on any rotary microtome provided with a knife clamp except No. 810.

A new principle for holding the blade is used. A wedge, pulled into place by a screw, exerts even pressure throughout the length of the blade and the design is such that very little strength is necessary to tighten the blade immovably in place. Thus, rigid as equal to that of a standard microtome knife can be obtained.

The blade is held in place by a screw which is pulled into the body of the holder which will prevent marking by the screws of the microtome knife holder.

Designed to hold any of the flat blades or non-backed knives not over 1 inch thick, this holder is an efficient and to good sectioning.

No.	Description	Price
966	Spencer Holder for safety razor blade	
967	Gillette Microtome Razor Blade extra heavy per pkg. of 10	

Spencer Razor Blade Holder No. 966





## Spencer Freezing Attachment for CO<sub>2</sub> No. 930

The Spencer Freezing Attachment No. 930 incorporates an insulating ring between the knurled plate, to which the object is frozen, and the rest of the apparatus.

This prevents the conduction of heat to the specimen from the other parts, thus saving time and gas.

The chamber is provided with a pin, like that on the object clamp, which fits into the socket on the microtome. The chamber is connected with the carbon dioxide cylinder by a flexible copper tube. This can be used on Nos. 850, 860, 880 and 900 microtomes.

In operating the valve at the chamber should first be closed and the valve at the cylinder be slightly opened to admit the gas into the tube, then by opening and closing the small valve at the chamber in quick succession, the tissue is frozen without waste of gas or inconvenience caused by the chamber or connections freezing up.



Freezing Attachment No. 930 as used on Nos. 850 and 900 Microtomes

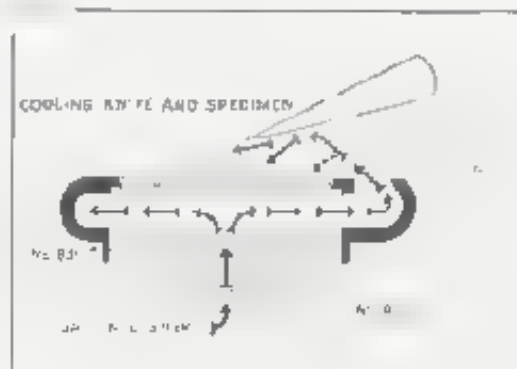
Cat. No.	Description
930	Freezing attachment complete with copper tube connections with 1/4 inch diameter freezing chamber

## Knife Cooling Deflector

The Knife Cooling Deflector fits around the specimen holder of the 930 Freezing Attachment and directs the exhaust gas against the under surface of the knife rather than in all directions around the head, thus cooling the knife simultaneously with the specimen.

The Deflector serves a dual purpose since some of the gas after striking the knife strikes the upper surface of the specimen which results in quicker and more uniform freezing of the specimen.

The amount of gas deflected on the tissue may be regulated by moving the knife nearer to or farther from the exhaust slot.

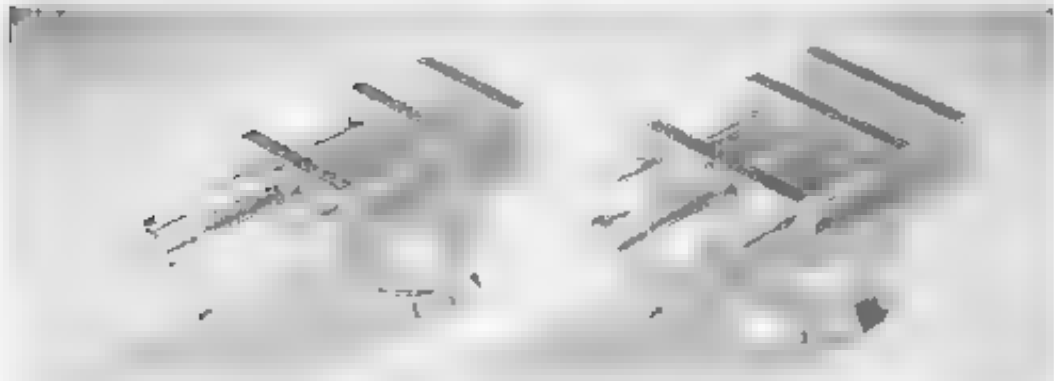


Knife Cooling Deflector

Cat. No.	Description
869	Knife Cooling Deflector



## Spencer Large Object Clamps



No. 828 Object Clamp

No. 863 Object Clamp

The Spencer Large Microtome Object Clamps Nos. 828 and 863 are designed to hold larger specimens. No. 828 may be used on Spencer Microtomes Nos. 820, 815, or 850. No. 863 may be used on No. 860.

The No. 828 clamp is  $1\frac{3}{4}$ " wide and the jaws will open a maximum of  $1\frac{3}{4}$ ". The depth is  $\frac{5}{8}$ ".

The No. 863 clamp is  $2\frac{1}{2}$ " wide and the jaws will open a maximum of 2". The

depth is  $\frac{5}{8}$ ". Both are heavily plated with nickel and chromium, and are easy to clean.

Cat. No.	Description	Price
828	1 $\frac{3}{4}$ " wide, 1 $\frac{3}{4}$ " deep, 1 $\frac{3}{4}$ " high	1.00
863	2 $\frac{1}{2}$ " wide, 2" deep, 2" high	1.50

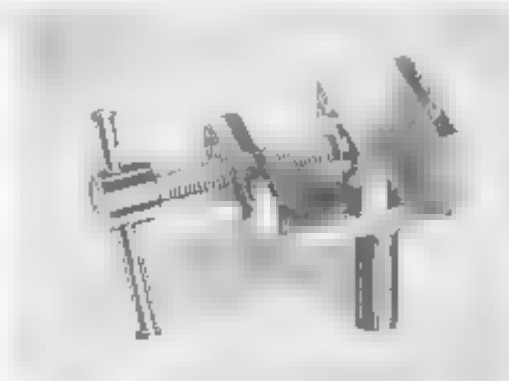
## Other Microtome Accessories

- 833  $\frac{5}{8}$ " diameter object disc for a 1" mt.
- 834 " " " " " " " "
- 835  $1\frac{1}{2}$ " diameter object disc for a 1" mt.

Object Disc No. 833, 834, 835

- 836  $1\frac{1}{2}$ " diameter object disc for a 1" mt.
- 837 Plate Oil for microtomes and hood

No. 836 Object Clamp

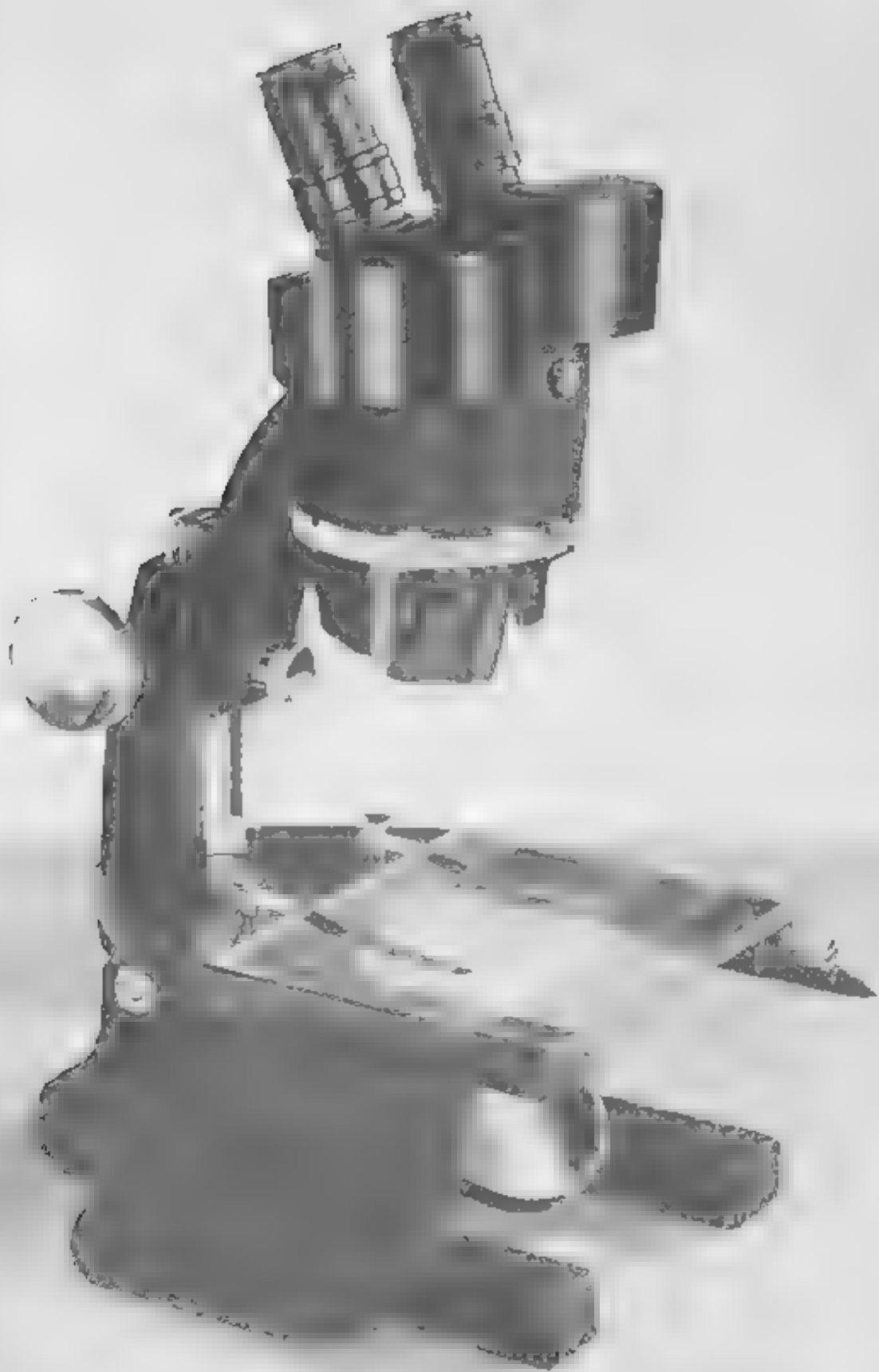




## Stereoscopic Microscopes

...of surface characteristics in the manufacture of precision mechanical parts. They ... parts or the dissection ... to reveal the struc ...







# Stereoscopic Microscopes

*also containing*

Greenough Microscopes  
Binocular Dissecting Microscopes  
Wide Field Binocular Microscopes  
Low Power Binocular Microscopes

Two distinctive characteristics of Spencer Stereoscopic Microscopes make them especially adaptable for a wide variety of applications. First, the image is erect, rather than inverted as with the regular non-objective microscope, and a 1/2 movements

of the object appear in their actual directions, not reversed. Second, the image has a real and natural depth which shows the characteristics of the specimen in their true perspective, rather than flat.

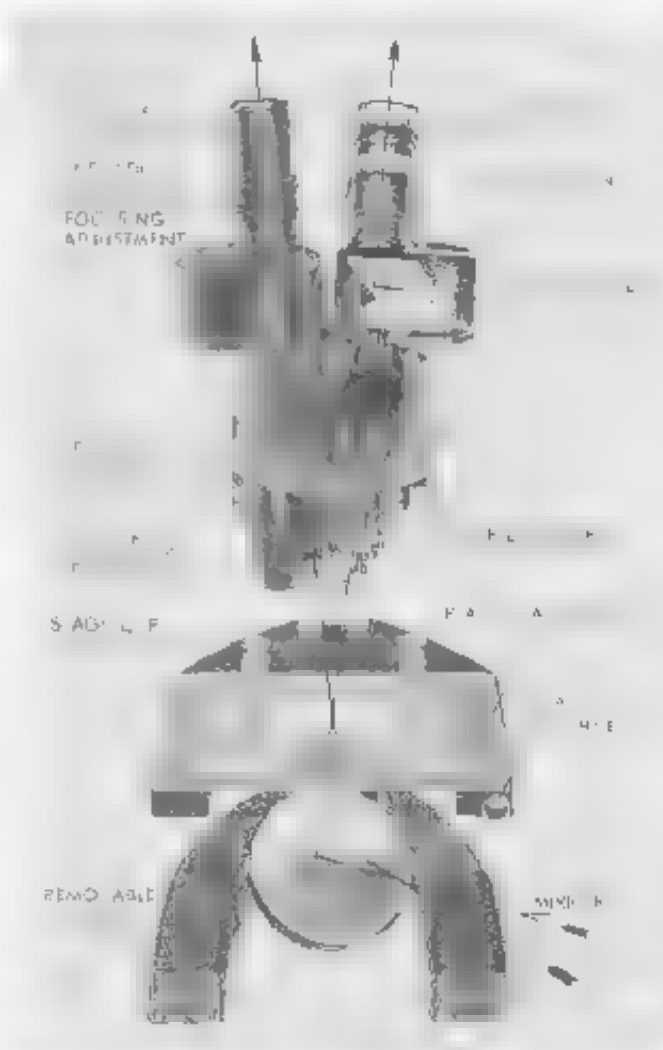
## Features of Construction

The design of the prism system in all stereoscopic microscopes provides a true image, so that in this respect all are equal. The unique prism system in Spencer Stereoscopic Microscopes, however, noticeably increases the perception of depth in the image. This is accomplished by having the axes of the paired objectives converging 12°. The prism system then bends the pencil of rays 2° toward the center so that the axes of the eyepieces converge at only 8°, which is the normal convergence of the eyes for reading and other close work. This accounts for the unusual comfort and ease in using the Spencer Stereoscopic Microscope.

## Optical Features

### Objectives

An important optical part of any microscope is the objective. Spencer paired objectives consist of two achromatically corrected lens combinations, centered and securely mounted in the holder. Satisfactory stereoscopic vision depends on depth of focus as well as angle. American Optical Company's scientists have found a





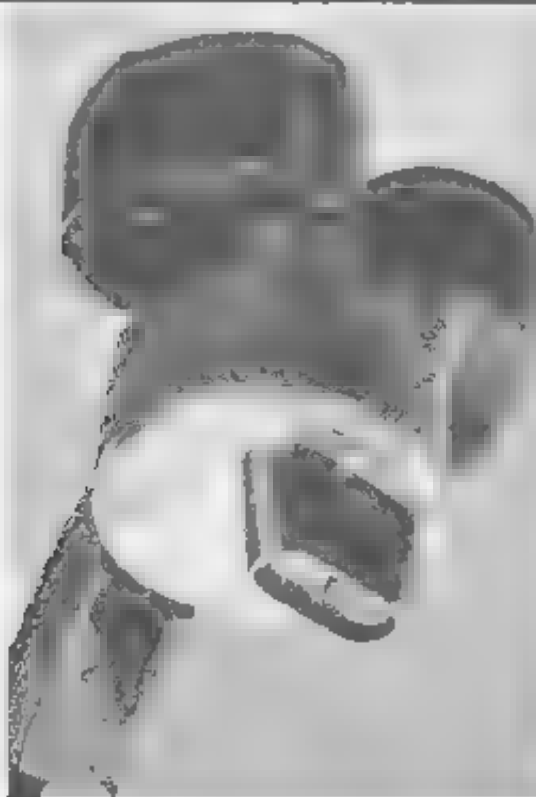


Fig. 1. (a) and (b) showing the parts of the microscope.

practical balance between depth of field and aperture, that provides depth as well as brilliant resolution.

The objective mounts are designed that the objectives can be changed quickly and easily on the microscope. Because of the positive method of attachment, the paired objective will always return to its original position.

### Eyeieces

The eyepieces for the Spencer Stereoscopic Microscope are designed to provide the exceptionally large field made available by the objectives. They are corrected for both chromatic aberration and curvature of field. The eye lenses are large and are unusually high eye-reliefs.

The eyepieces are designed to provide a wide range of magnification. They are corrected for both chromatic aberration and curvature of field. The eye lenses are large and are unusually high eye-reliefs.

### Range of Magnification

The wide range of magnification available on the Spencer Stereoscopic Microscope, from 6.3X to 144X, is achieved by seven different objectives, and four different eyepieces. The combination of paired eyepieces provides a total of 23 different magnifications within this range.

Table of Magnifications and Fields of View

OBJECTIVES			EYEPIECES				
Designation	Serial Number	Magnification	No. 1135	No. 1136	No. 1137	No. 1138	No. 1139
10X	1000	10X	24 diam. 28.3mm. 10.0mm.	10.5	24 diam. 28.3mm. 10.0mm.	12.6	16.5mm. 12.6mm.
20X	2000	20X	12.0	12.0	12.0	12.0	12.0
40X	4000	40X	6.0	6.0	6.0	6.0	6.0
60X	6000	60X	4.0	4.0	4.0	4.0	4.0
80X	8000	80X	3.0	3.0	3.0	3.0	3.0
100X	10000	100X	2.4	2.4	2.4	2.4	2.4
125X	12500	125X	2.0	2.0	2.0	2.0	2.0
150X	15000	150X	1.6	1.6	1.6	1.6	1.6
180X	18000	180X	1.3	1.3	1.3	1.3	1.3
200X	20000	200X	1.2	1.2	1.2	1.2	1.2
250X	25000	250X	1.0	1.0	1.0	1.0	1.0
300X	30000	300X	.8	.8	.8	.8	.8
400X	40000	400X	.6	.6	.6	.6	.6
500X	50000	500X	.5	.5	.5	.5	.5
600X	60000	600X	.4	.4	.4	.4	.4
800X	80000	800X	.3	.3	.3	.3	.3
1000X	100000	1000X	.25	.25	.25	.25	.25

## Two Binocular Bodies

In addition to the vertical binocular bodies, inclined bodies which have the eyepieces inclined toward the observer can be supplied at a small additional cost. Inclined bodies are available on all stands and are selected most universally for research work, or in any application requiring prolonged periods of observation. Inclination of the eyepieces enables the observer to maintain comfortable posture. Eyes, neck, and shoulders are in a normal, restful position during observation.

## Mechanical Features

### Adjustments

In addition to the adjustment for interpupillary distance, all instruments are provided with a means of adjusting the eyepiece to compensate for differences

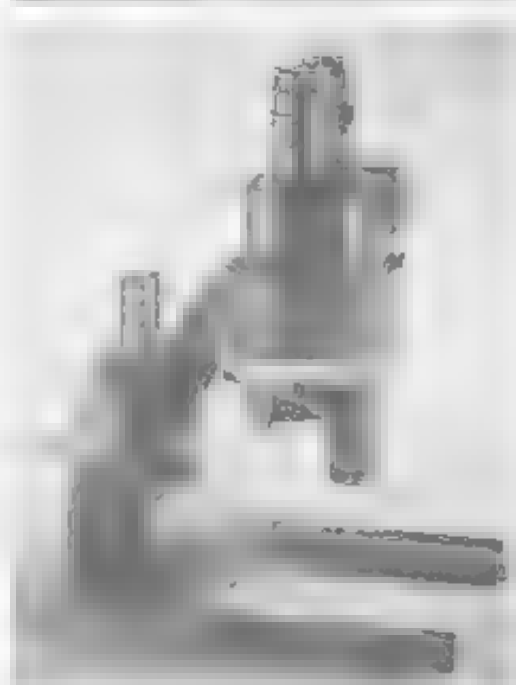
between the eyes of the observer. Vertical adjustment of the microscope is by diagonal rack and spiral pinion. The microscope body is attached to the rack by means of a slide which greatly extends the range of movements over that which would be possible with the rack and pin-

## The Multiple Revolving Nosepiece

The multiple revolving nosepiece has important advantages. Just will not settle on the back lenses of the objectives, because of the dust-tight construction of the nosepiece, nor on the front lenses, for the objectives are never tipped out of the vertical position. It will accommodate any three Spencer paired objectives and affords a most convenient means of changing magnifications. The periphery is knurled, providing a good grip to assure smooth rotation.

The paired objectives rotate about the optical axis and the arm. This arrangement facilitates rapid positioning of the specimen and eliminates the possibility of shadows on the subject of observation as there are no parts extending out in front of the optical axis.

*Illustrations show comparatively great range of adjustment  
top, for high object; below, focused on table.*





## Spencer Stereoscopic Microscopes No. 25 and No. 25L

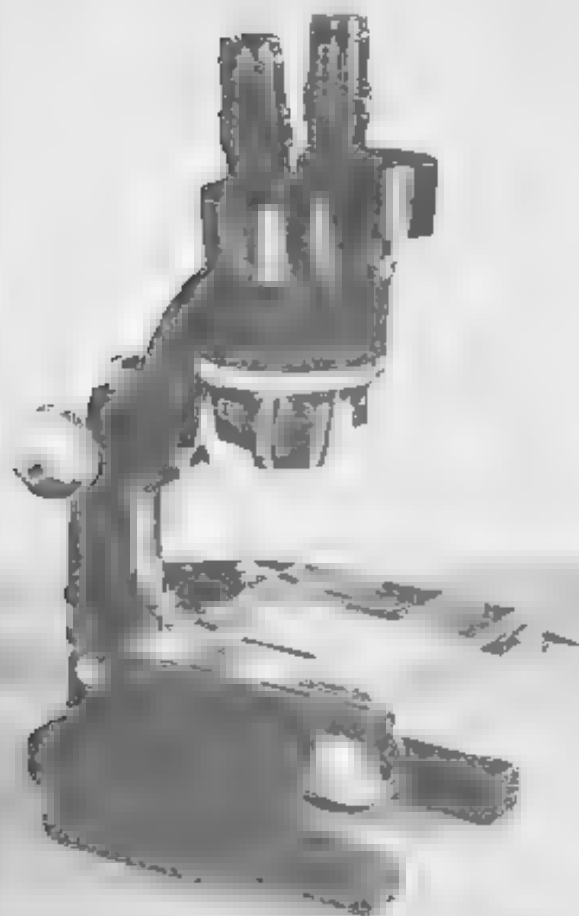
These microscopes are identical except for the binocular bodies. The No. 25 has a vertical binocular body. The No. 25L has an inclined binocular body. The angle of inclination is 22° from the vertical.

The Spencer Stereoscopic Microscope No. 25 is supported on a large, heavy, stable base,  $5\frac{1}{2}$ " wide and 8" long. Careful study was given to the stage height to provide sufficient space ( $3\frac{1}{4}$ "") above the table, thereby insuring proper illumination from the large (60 cm) reversible mirror. As a result, maximum comfort can be maintained in manipulation. The stage

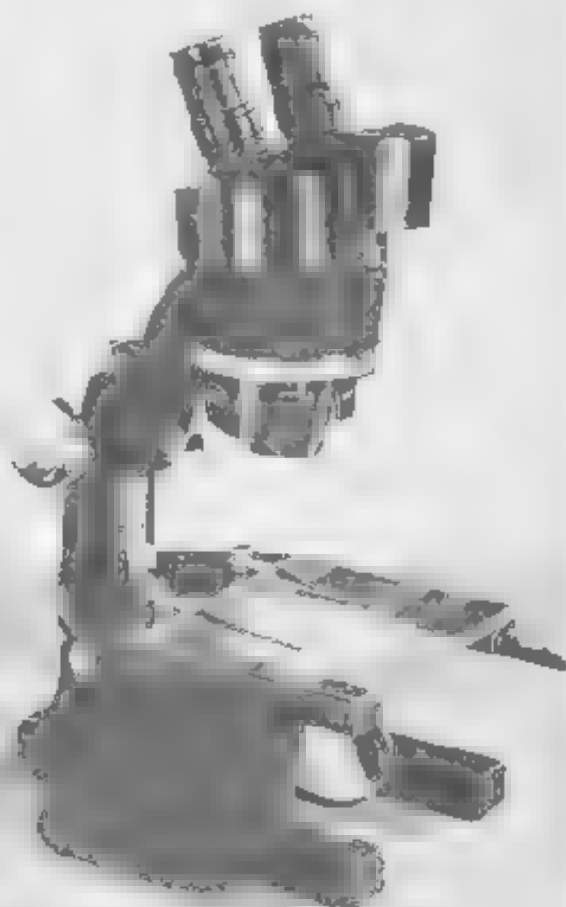
level stage, 5" x 7", has a flesh top and provides for the use of the No. 484 ungraduated mechanical stage. The stage clips can be used in two positions so that a very large or a comparatively small object can be fixed securely in position. A long distance is provided ( $3\frac{1}{2}$ "") between the optical axes and the table.

A  $2\frac{1}{8}$ " excursion of the rack and the movement in the side mounting of the body gives a total range of  $4\frac{3}{4}$ " and makes possible observations on exceptionally large objects. The instrument has an inclination joint permitting inclination to

*Spencer Stereoscopic Microscope No. 25F*



*Spencer Stereoscopic Microscope No. 25L*





an angle of 45° and ensuring stability in any position. A metal background plate, black on one side and white on the other, fits into a slot beneath the glass stage. The glass stage is removable so that it can be washed easily when dirty or replaced with a new one if damaged.

A thumb screw holds the base and upper part of the instrument together. By releasing this screw, the base can be removed if it is found desirable to use this instrument as No. 26. Hand rests are not used.

A selection of various optical combinations which have proved most generally useful is shown below. The stands are used without optics, so that by selecting objectives and eyepieces listed on page of accessories and consulting the price list, the price of any combination for individual requirements can be readily determined.



The large tree, white, shown above, has a 9 inch top

The equipments listed are only suggestions for useful combinations. The purchaser can make up his own equipment by taking the price of stands 25A or B and 25LA or LB and adding to them the objectives and eyepieces desired. See page of accessories for listings of these optics.

24A Spencer Stereoscopic Microscope stand with vertical binocular body having a single paired object adapter but without paired or eyepieces. Purchased for \$100.00.

24B Spencer Stereoscopic Microscope stand with vertical binocular body having a single paired object adapter but no eyepieces. Magnification 13X. Purchased in a leatherette cover for \$100.00.

24C Spencer Stereoscopic Microscope with vertical binocular body having a multiple revolving nosepiece with 1.0X, 2.0X, and 3.0X paired objectives, 9X and 2X paired eyepieces. Magnifications 9X to 36X. For \$100.00.

Spencer Stereoscopic Microscope with vertical binocular body with 1.0X, 2.0X, and 3.0X paired objectives, 9X and 2X paired eyepieces. Magnifications 9X to 36X. For \$100.00.

[illegible]



## Spencer Stereoscopic Microscope No. 26 and No. 26L

These microscopes are identical, except for their binocular bodies. The No. 26 has a vertical binocular body. The No. 26L has an inclined binocular body. The angle of inclination is  $22^{\circ}$  from the vertical.

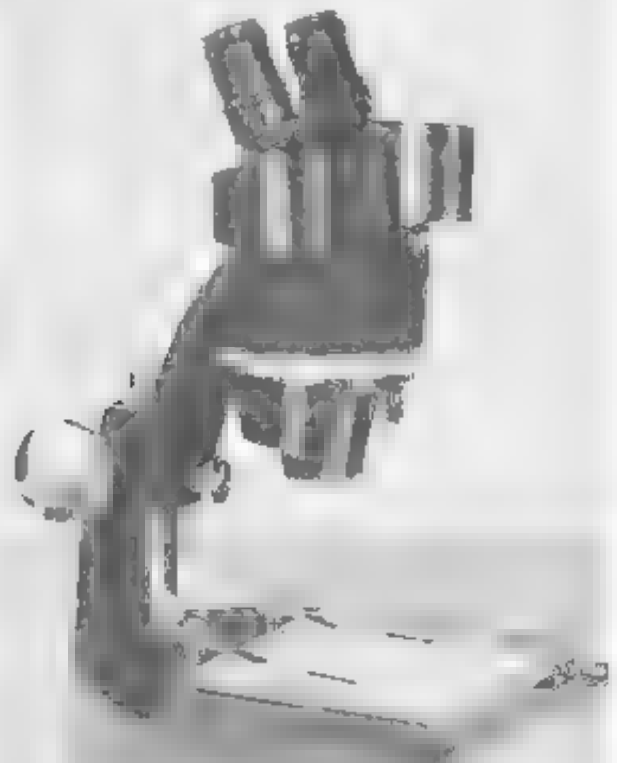
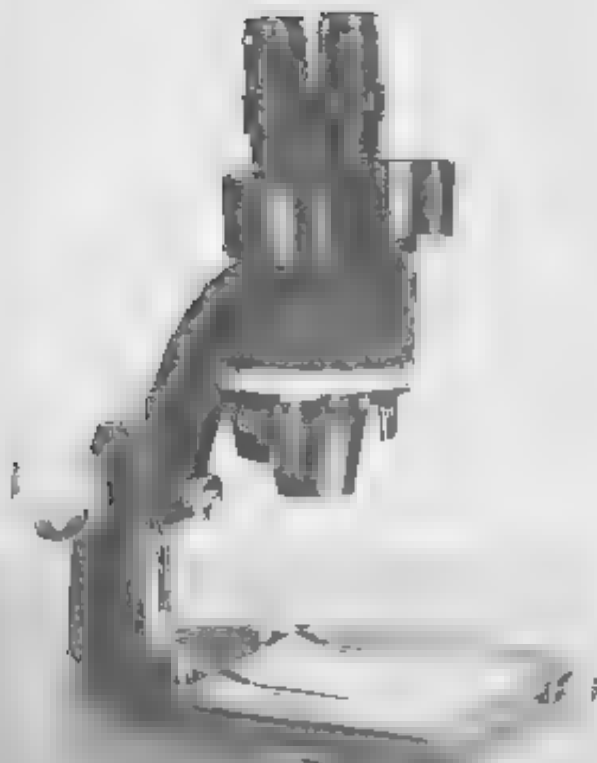
The Spencer Stereoscopic Microscope No. 26 is the same as the upper part of No. 25, except that the glass stage and eyepiece joint removed. The glass stage is hinged and may be moved to a point where (with the glass stage removed) one may focus on any portion of the large area on which the instrument

may be placed. This instrument is a factory for any work where transmitted light is not used, and it can be equipped with a base and converted into a No. 25 at any future time.

The equipments listed are only suggestions. The purchaser can make up his own equipment by selecting from the accessories for No. 26LA or LB and adding to them the objectives and eyepieces desired. See page accessories for listings of these optics.

Spencer Stereoscopic Microscope No. 26L

Spencer Stereoscopic Microscope No. 26L







## Spencer Stereoscopic Microscope No. 28 and No. 28L

These microscopes are identical except for their binocular bodies. The No. 28L has a 1° inclined binocular body. The angle of inclination is 22° from the vertical.

In certain types of work, the advantages of the No. 25 microscope should be combined with the flexibility of movement of the No. 23. Such a combination is presented in the Spencer model No. 28.

The stand is sturdy, rigid, and well constructed, with the long slide of the microscope so designed that it permits tilting on the table when the base of the instrument is removed. The binocular body is fastened to this slide by a jointed arm which carries the microscope body to any position in a horizontal plane over the specimen. The two parts

of the microscope body are so arranged that they always come directly over the center of the specimen on the stage, in which position they remain when the microscope is tilted.

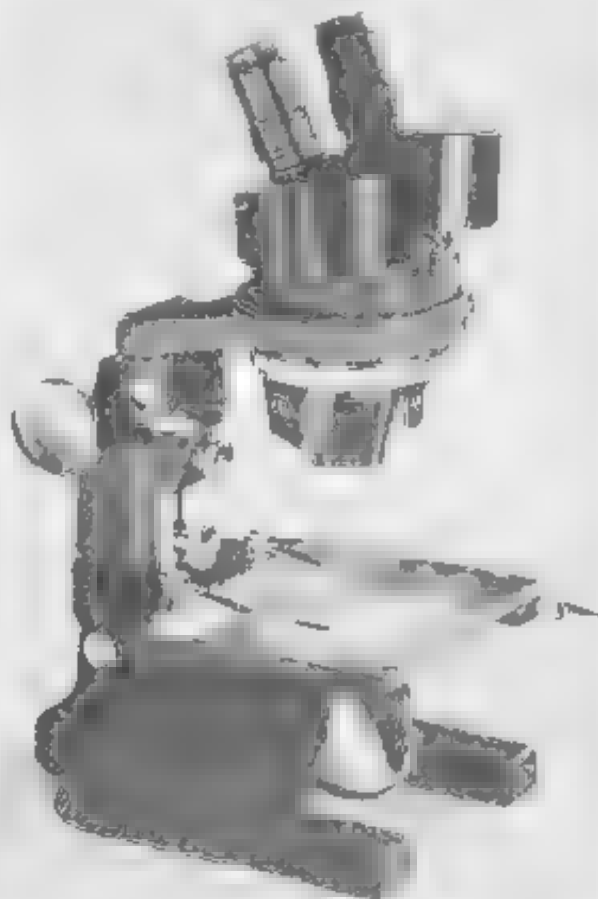
The mirror is mounted in a universal joint. Hand rests accompany the microscope. A horizontal dovetail slide holds the upper part of the microscope to the base. A single set screw clamps this tightly in position.

A nicely finished hardwood board, 12 $\frac{3}{4}$ " x 8 $\frac{1}{4}$ ", grooved on the underside, is provided for covering the stage of the microscope. This large plane surface is ideal for holding herbarium sheets, fossils, or other large objects. It is also useful for quick scanning of groups of small mechanical parts, such as bearings and fl.

*Spencer Stereoscopic Microscope No. 28P*



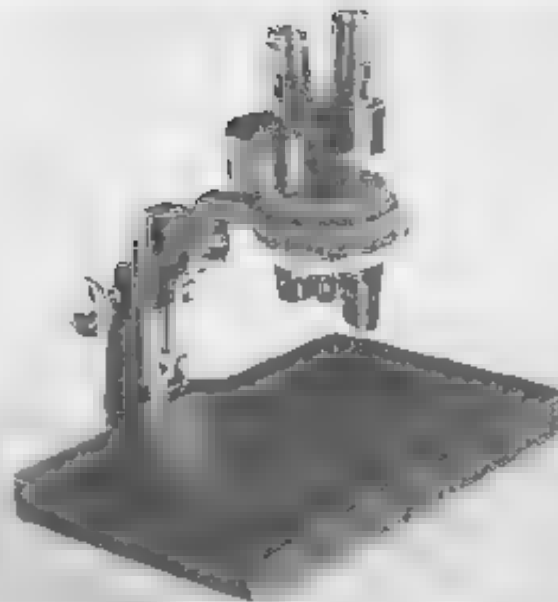
*Spencer Stereoscopic Microscope No. 28LP*





Because of the manner in which the binocular body is swiveled and revolves 360° in its ring mount, it is possible to examine a large area quickly, always keeping the eyepieces in a comfortable relation to the eyes by grasping the binocular body and moving as desired. When a fixed position is desired, the joints may be firmly clamped.

The equipments listed are in combinations for useful combinations. The purchaser can make up his own equipment by taking the price of stands 28A or B and 28LA or LB and adding to them the objectives and eyepieces desired. See page of accessories for listings of these optics.



Upper part of No. 28L equipment with horizontal band instead of, glass stage

Cat. No.	Description	Price
28A	Spencer Stereoscopic Microscope having a single paired objective adapter but without paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.	
28B	Same as above but with multiple revolving nosepiece.	
28LA	Spencer Stereoscopic Microscope with vertical binocular body having a single paired objective adapter with 2.0X narrow objectives, 9X paired eyepieces, etc. Furnished in a leatherette covered hardwood cabinet.	
28LB	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece with 1.0X, 2.0X and 3.0X paired objectives, 9X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.	
28C	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece with 1.0X, 3.0X and 6.0X paired objectives, 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.	

Cat. No.	Description	Price
28LA	Spencer Stereoscopic Microscope having a single paired objective adapter but without paired objectives or paired eyepieces. Furnished in a leatherette covered hardwood cabinet.	
28LB	Same as above but with multiple revolving nosepiece.	
28LA	Spencer Stereoscopic Microscope with vertical binocular body having a single paired objective adapter with 2.0X narrow objectives, 9X paired eyepieces, etc. Furnished in a leatherette covered hardwood cabinet.	
28LB	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece, with 1.0X, 2.0X and 3.0X paired objectives, 9X and 15X paired eyepieces. Magnifications 9X to 36X. Furnished in a leatherette covered hardwood cabinet.	
28LC	Spencer Stereoscopic Microscope with vertical binocular body, multiple revolving nosepiece with 1.0X, 3.0X and 6.0X paired objectives, 9X and 15X paired eyepieces. Magnifications 9X to 90X. Furnished in a leatherette covered hardwood cabinet.	





## Spencer Stereoscopic Microscope No. 23 and No. 23L

Spencer Stereoscopic Microscope No. 23 is especially for work on large objects which could not be placed conveniently on the stage of the No. 25 or No. 26. The object may be observed anywhere within a circle four feet in diameter by means of this equipment.

The regular microscope rack and

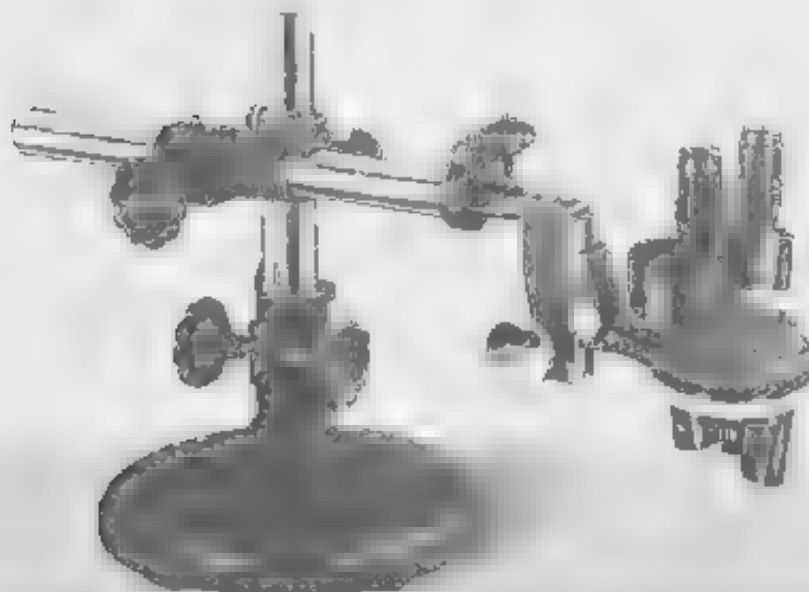
The heavy 10" diameter base makes the vertical pillar 23½", carrying both horizontal arm and microscope. The horizontal arm is moved through 4½" by rack and pinion and has an inner tube which extends the arm 7" a total range of horizontal movement of 11½". The

vertical height for viewing the surface details of large bodies. The microscope can be moved up and down 1½" from the central pillar. Clamps are provided for fixing the instrument in any position.

The binocular body is mounted in a ring that permits rotation, (360°) to the most convenient position for observations. A very desirable feature for certain types of work. Note that the objectives are mounted below the other parts so that objects may be observed in a deep dish without interference from the sides of the dish. Vertical and inclined binocular bodies are available. The designation "L" in the catalog number indicates the inclined binocular body.

There is no case for the stand, but a leatherette covered carrying case is provided for the binocular body and optics.

The equipments listed are only suggestions for useful combinations. The purchaser can make up his own equipment by taking the price of stands 23A or B and 23L A or LB and adding to them the objectives and eyepieces desired. See page of accessories for listing of these optics.



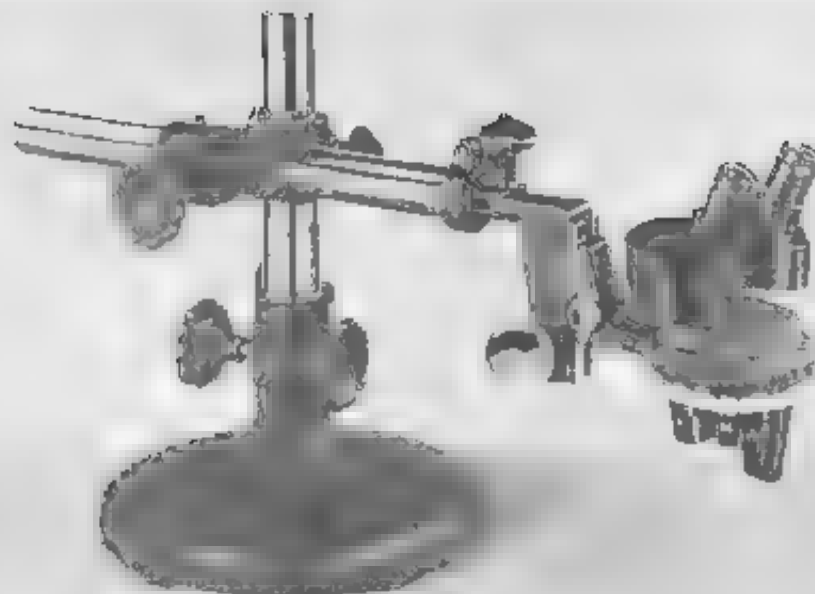


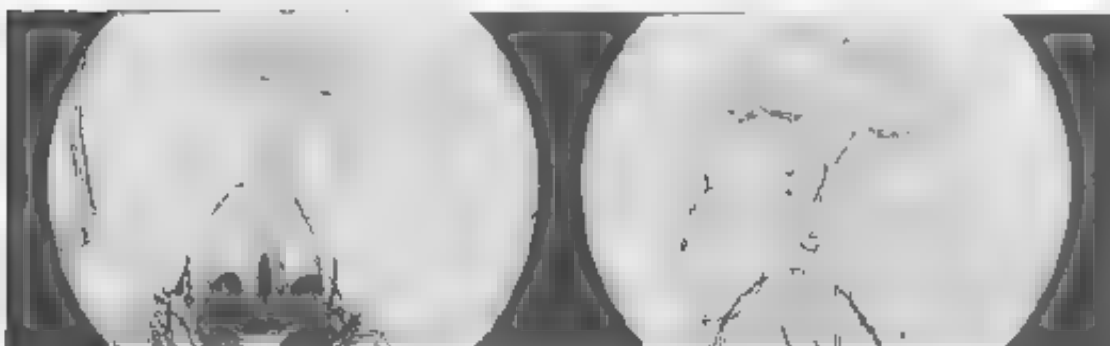
Fig. 10. Spencer Stereoscopic Microscope, Model No. 23LF

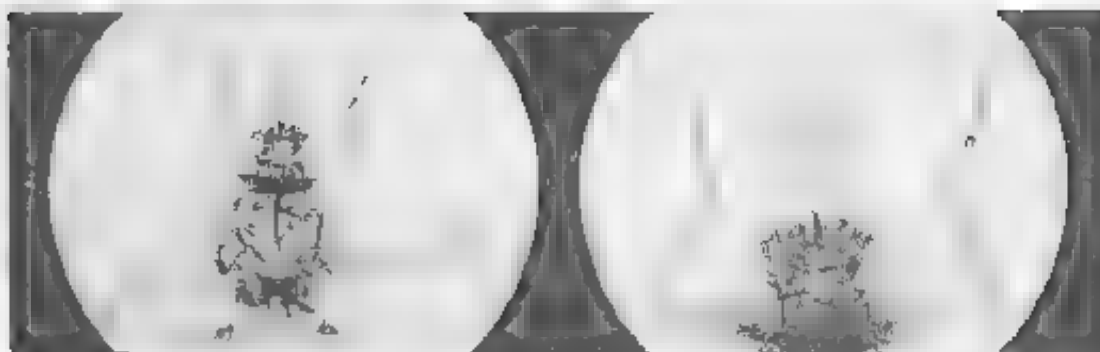
Cat. No.	Description	Cat. No.	Description
23A	Spencer Stereoscopic Microscope stand with vertical binocular body having a single paired objective adapter but without paired objectives or paired eyepieces. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.	23LA	Spencer Stereoscopic Microscope stand with inclined binocular body, having a single paired objective adapter, but without paired objectives or paired eyepieces. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.
23B	Same as above but with multiple revolving nosepiece.	23LB	Same as above but with multiple revolving nosepiece.
23C	Spencer Stereoscopic Microscope with vertical binocular body having a single paired objective adapter, with 1.0X paired objectives, 9X paired eyepieces. Magnification 18X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.	23LC	Spencer Stereoscopic Microscope with inclined binocular body having a single paired objective adapter, 1.0X paired objectives, 9X eyepieces. Magnification 18X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.
23D	Spencer Stereoscopic Microscope with vertical binocular body and multiple revolving nosepiece, with 1.0X, 2.0X and 3.0X paired objectives, 9X eyepieces. Magnification 18X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.	23LF	Spencer Stereoscopic Microscope with inclined binocular body and multiple revolving nosepiece, with 1.0X, 2.0X and 3.0X paired objectives, 9X and 15X paired eyepieces. Magnification 18X to 36X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.
23E	Spencer Stereoscopic Microscope with vertical binocular body and multiple revolving nosepiece, with 1.0X, 3.0X and 6.0X paired objectives, 9X and 15X paired eyepieces. Magnification 18X to 36X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.	23LE	Spencer Stereoscopic Microscope with inclined binocular body and multiple revolving nosepiece, with 1.0X, 3.0X and 6.0X paired objectives, 9X and 15X paired eyepieces. Magnification 18X to 36X. A leatherette covered hardwood cabinet is supplied to hold the binocular body and optics only.
23F	Same as above of No. 23 Microscope with rack and pinion.	23F	Same as above of No. 23 Microscope with rack and pinion.



## Recommended Equipment

Equipment		Description	
1. 1000	1000	1000	1000
2. 1000	1000	1000	1000
3. 1000	1000	1000	1000
4. 1000	1000	1000	1000
5. 1000	1000	1000	1000
6. 1000	1000	1000	1000
7. 1000	1000	1000	1000
8. 1000	1000	1000	1000
9. 1000	1000	1000	1000
10. 1000	1000	1000	1000
11. 1000	1000	1000	1000
12. 1000	1000	1000	1000
13. 1000	1000	1000	1000
14. 1000	1000	1000	1000
15. 1000	1000	1000	1000
16. 1000	1000	1000	1000
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18. 1000	1000	1000	1000
19. 1000	1000	1000	1000
20. 1000	1000	1000	1000
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31. 1000	1000	1000	1000
32. 1000	1000	1000	1000
33. 1000	1000	1000	1000
34. 1000	1000	1000	1000
35. 1000	1000	1000	1000
36. 1000	1000	1000	1000
37. 1000	1000	1000	1000
38. 1000	1000	1000	1000
39. 1000	1000	1000	1000
40. 1000	1000	1000	1000
41. 1000	1000	1000	1000
42. 1000	1000	1000	1000
43. 1000	1000	1000	1000
44. 1000	1000	1000	1000
45. 1000	1000	1000	1000
46. 1000	1000	1000	1000
47. 1000	1000	1000	1000
48. 1000	1000	1000	1000
49. 1000	1000	1000	1000
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51. 1000	1000	1000	1000
52. 1000	1000	1000	1000
53. 1000	1000	1000	1000
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58. 1000	1000	1000	1000
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70. 1000	1000	1000	1000
71. 1000	1000	1000	1000
72. 1000	1000	1000	1000
73. 1000	1000	1000	1000
74. 1000	1000	1000	1000
75. 1000	1000	1000	1000
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77. 1000	1000	1000	1000
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81. 1000	1000	1000	1000
82. 1000	1000	1000	1000
83. 1000	1000	1000	1000
84. 1000	1000	1000	1000
85. 1000	1000	1000	1000
86. 1000	1000	1000	1000
87. 1000	1000	1000	1000
88. 1000	1000	1000	1000
89. 1000	1000	1000	1000
90. 1000	1000	1000	1000
91. 1000	1000	1000	1000
92. 1000	1000	1000	1000
93. 1000	1000	1000	1000
94. 1000	1000	1000	1000
95. 1000	1000	1000	1000
96. 1000	1000	1000	1000
97. 1000	1000	1000	1000
98. 1000	1000	1000	1000
99. 1000	1000	1000	1000
100. 1000	1000	1000	1000





## Selecting Your Instrument

After studying the general features of the Spencer Stereoscopic Microscope, the following facts will assist you in deciding on the type of instrument most convenient for your use and the optical equipment it should contain.

There are four different mechanical arrangements:

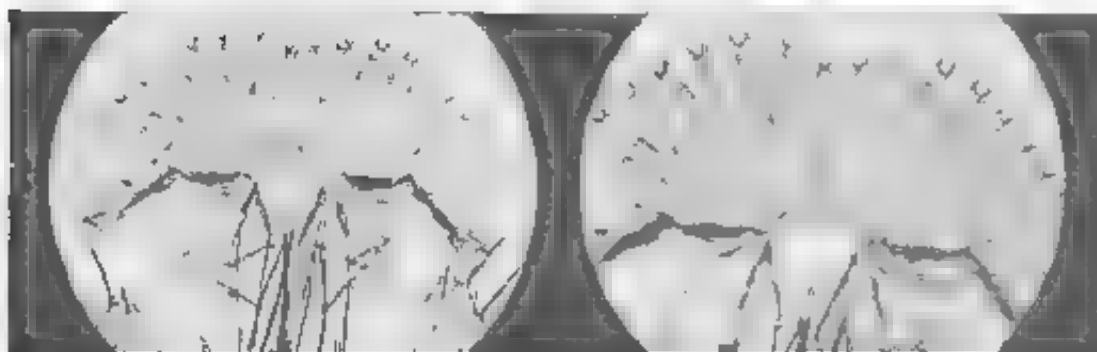
1. No. 26 for small opaque objects requiring only vertical adjustment of focus.
2. No. 25 for small opaque or transparent objects requiring only vertical adjustment of focus.
3. No. 28 for small opaque or transparent objects requiring both vertical and horizontal adjustment.

4. No. 23 for large opaque objects that require universal adjustment for special observations.

Selecting the most useful magnification is often difficult. Too often an observer selects high magnification and is then troubled by the disadvantage of smaller fields and limited depths of focus. It is best to select the lowest power that you believe will give satisfactory detail.

Compare the smallest unit that you wish to examine with the insect (fruit fly) shown above marked 1X and follow this through to higher magnifications. The photomicrographs illustrate the decreased field of view which accompanies increase in magnification.

Designation	Mounting	Objective	Field of View
A	Single	4X	4X
B	Single	4X	4X
F	Multiple	4X 10X 20X	4X 10X 20X 25X
G	Multiple	4X 10X 20X	25X 30X 40X





## Accessories for Stereoscopic Microscopes

### Paired Objectives

No.	Description	Price
105	30X Paired Objectives	
106	40X Paired Objectives	
107	60X Paired Objectives	
108	80X Paired Objectives	

### Paired Eyepieces

No.	Description	Price
109	9X Paired Eyepieces	
110	25X Paired Eyepieces	
111	15X Paired Eyepieces	

### Mechanical Stage

No.	Description	Price
112	Mechanical Stage to fit Spencer Nos. 25 and 26 Microscopes	

### Miscellaneous Accessories

No.	Description	Price
113	Slide with cover or seal for converting No. 26 Microscope to No. 25	
114	Glass Stage Plate for Nos. 25, 26, and 28 Microscopes	
115	Cabinet for No. 25	
116	Cabinet for No. 26	
117	Cabinet for No. 28	



Paired Eyepieces in a microscope Mounting

### Universal Microscope Lamps

The Spencer Universal Microscope Lamp was designed especially for use with the Spencer Stereoscopic Microscopes. It attaches without special adaptation to the body tube of any of the stereoscopic microscopes except the Junior series or can be used on its own base by using the No. 478 adapter, this lamp can be attached to the stage of the Nos. 25, 26, or 28 Microscopes.

No.	Description	Price
454	Universal Microscope Lamp with 6.5 volt 25 watt incandescent lamp bulb, blue	
455	Adapter for No. 353	
456	Clear Bath, 6.5 volt, 25 watt	
478	Bracket for attaching No. 353 to stage of microscopes Nos. 25, 26, or 28	
479	Bracket for attaching No. 353 lamp to body tube of our series low power binocular microscopes, No. 35 series	

Accessories are available for adapting the round body of the No. 25 Microscope to the No. 25 or No. 26 stand. Price and description will be furnished on request.

### Paired Objectives





## Micrometer and Reticule Accessories for Stereoscopic Microscopes

In all eyepieces (Catalog Nos. 1184, 1185, 1186 and 1187) listed for the Spencer Stereoscopic Microscope, the diaphragms are constructed to hold reticules or micrometer discs. The combination diaphragm and reticule holder screws into the lower end of the eyepiece and can be adjusted to the best position to provide sharp focus for an individual's eye. A spanner wrench, included with each Stereoscopic Microscope, is used to make the correct setting.

The discs listed will be found useful in measuring small details, in drawing and in counting.

### Directions

With the spanner wrench, unscrew the diaphragm from the bottom of the eyepiece. Place the reticule or micrometer disc (with etched notes down) in the diaphragm. Then place the retaining ring over the reticule or micrometer disc to hold it securely.

Next replace the diaphragm in the eyepiece tube. Fit the spanner wrench into the slot in the bottom of the diaphragm with the left hand. With the right hand hold the eyepiece in the line of vision, toward a diffusely illuminated object such as the sky or a frosted lamp. While holding the spanner wrench in the diaphragm's slot, the eyepiece should be rotated with the right hand until the etched lines appear in sharp focus. The wrench is so constructed that the light entering the eyepiece is not obstructed and a clear view of the etched lines is obtained.

The eyepiece in which the reticule or micrometer disc has been inserted is now ready for use and should be placed in the fixed eyepiece tube.<sup>†</sup>

The lower magnifications may be calibrated by the micrometer. The micrometer is preferably divided in half millimeters and the eyepiece micrometer scale is used to measure the true length of the object. You will note the true length of the object by multiplying the given number of divisions ( $\frac{1}{2}$  in the eyepiece micrometer). Then the scale value of the single eyepiece division is  $x+y=z$ . Where  $x$  is the number of divisions of the eyepiece micrometer subtended by the object. The value of  $z$  must be determined for each combination of eyepiece and objective used, once determined it is constant for all combinations in the lenses of microscope.

†The adjustable eyepiece tube varies the tube length slightly which changes the calibration factor  $x$  of the micrometer scale.

Cat.	Description	Price
1184	Micrometer Disc, 20.0mm diameter	1.00
1185	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1186	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1187	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1188	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1189	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1190	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1191	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1192	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1193	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1194	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1195	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1196	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1197	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1198	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1199	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00
1200	Micrometer Disc, 20.0mm diameter, with 5mm scale divided into 100	1.00

\*When used with 18X eyepieces, there is a partial cutoff at the corners on account of the diaphragm.



No. 1185

No. 1187

†Illustrations show items reticulated. Size of etched area appearing in field depends upon power of the eyepiece.



# Junior Stereoscopic Microscopes

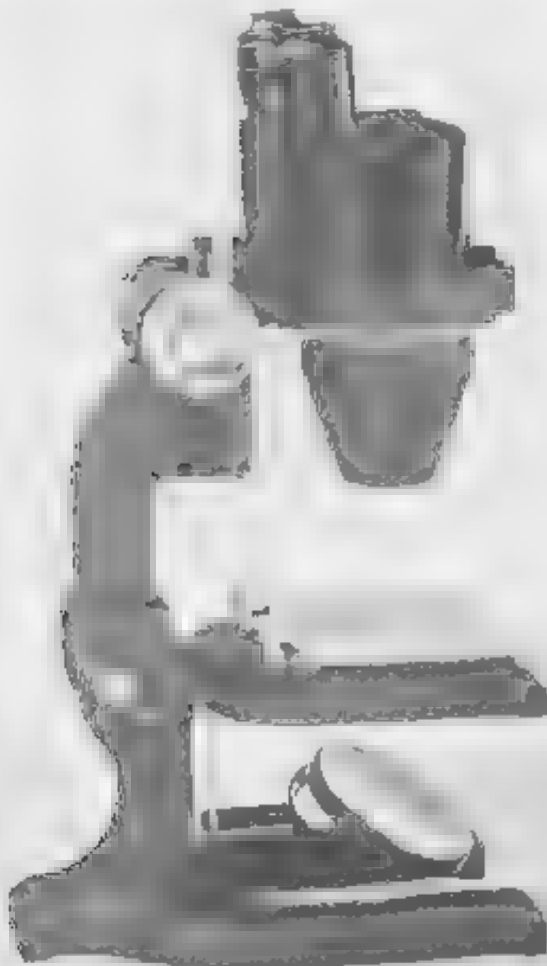
The Spencer Junior Stereoscopic Microscopes Nos. 57, 67, and 77 were designed for use in the classroom where the range of magnification and mechanical features are of primary importance.

In developing these instruments, the principal saving was made in the mechanical construction. This reduction could not be great for every double objective microscope is really two instruments with two eyepieces.

## Features of Construction

Aside from a somewhat simpler and less pretentious stand, the principal saving lies in the fact that the objectives are mounted integrally with a part corresponding to the revolving nosepiece, in the simplified prism system. Two pairs of objectives instead of three pairs are included. Each objective is mounted in a quadrant of the revolving part, one of each pair being in opposite quadrants, on either side of the center of revolution. To put one pair of objectives out of operative relation, and the other pair in, requires a revolution of the unit through  $90^\circ$ . The objectives in each unit are protected from dust by a surrounding shield. A single nosepiece adapter is supplied instead of the revolving means, when only one paired objective is ordered.

Spencer Junior Stereoscopic Microscope No. 57



## Objectives

The objectives are so mounted that the axes of the objectives in each pair subtend an angle of  $16^\circ$ , the beam of light from each objective is bent  $4^\circ$  toward the normal in the baffle prism boxes. This means that the observer looks into the microscope at the normal, natural angle of  $8^\circ$  convergence. The erection of the image in the prism boxes is accomplished by means of two mirror prisms in each box instead of three as in higher priced instruments.

## Eyepieces

The eyepiece sockets are of standard diameter to take any of the eyepieces used on the single objective microscopes. The regular Huyghenian eyepieces give very good results, especially in the lower powers. For the higher powers we strongly recommend the Wide Field eyepieces, which give a very large flat field and a pleasing picture.

## Range of Magnifications

Magnifications from 6X to 136X are available. The most useful combinations



Unit A consists of a pair each of 1.5X and 2.3X objectives shown on No. 57V, the other unit, C, includes the 1.5X and 2.3X objectives shown on No. 57W. The bulk of the work is done with these powers. With 10X and 4X objectives magnifications of 15X and 9.2X respectively. Where one pair of objectives will suffice, as shown on No. 77 they may be had in the regular mounts. The adapter holding these mounts is interchangeable with the double units, and the mounts are interchangeable on the adapter, as they are on the multiple nosepiece used on the larger microscopes.

### Stands

The stand is well proportioned as shown by the illustration. The glass stage, 75mm x 100mm., is so mounted on the stage arm that the white or black background may be used beneath the glass. The free distance between the optical axis and the arm is 75mm. The declination joint is separable. By this means the base and mirror (60mm. diameter) may be removed from the rest of the microscope. This microscope then becomes No. 67. Using a steel cylinder and less expensive base, the stand becomes No. 77.

Each instrument is regularly supplied in a substantial leatherette covered hardwood carrying case.

*Spencer Junior Stereoscopic Microscope No. 77*



No.	Description	Price
57R	Junior Stereoscopic Microscope with objective 1.5X and paired Huyghenian eyepieces 10X. Total magnification 15X.	
57V	Junior Stereoscopic Microscope with Unit A composed of 1.5X and 2.3X paired objectives and paired Huyghenian eyepieces 10X. Total magnification 10X and 14X.	
57W	Junior Stereoscopic Microscope with Unit C composed of 1.5X and 4X paired objectives and paired Huyghenian eyepieces 10X. Total magnification 1.5X and 14X.	
57X	Junior Stereoscopic Microscope with Unit D composed of 1.5X and 10X paired objectives and paired Wide Field eyepieces 15X. Total magnification 5X and 51X.	
57Y	With same optics as No. 57R.	
57Z	With same optics as No. 57V.	
57A	With same optics as No. 57W.	
57B	With same optics as No. 57X.	
57C	With same optics as No. 57Y.	
57D	With same optics as No. 57Z.	
57E	With same optics as No. 57A.	
57F	With same optics as No. 57B.	
57G	With same optics as No. 57C.	
57H	With same optics as No. 57D.	
57I	With same optics as No. 57E.	
57J	With same optics as No. 57F.	
57K	With same optics as No. 57G.	
57L	With same optics as No. 57H.	
57M	With same optics as No. 57I.	
57N	With same optics as No. 57J.	
57O	With same optics as No. 57K.	
57P	With same optics as No. 57L.	
57Q	With same optics as No. 57M.	
57R	With same optics as No. 57N.	
57S	With same optics as No. 57O.	
57T	With same optics as No. 57P.	
57U	With same optics as No. 57Q.	
57V	With same optics as No. 57R.	
57W	With same optics as No. 57S.	
57X	With same optics as No. 57T.	
57Y	With same optics as No. 57U.	
57Z	With same optics as No. 57V.	







## Magnifications and Fields of Junior Stereoscopic Microscopes

EYEPieces	1.0X Objective		1.7X Objective		2.3X Objective		3.4X Objective	
	Field of view in mm.	Magn.	Field of view in mm.	Magn.	Field of view in mm.	Magn.	Field of view in mm.	Magn.
10X Wide Field	13.2	10X	10.4	17.0X	7.3	34.4X	5.0	35.4X
5X Wide Field	13.2	20X	10.4	34.0X	7.3	68.8X	5.0	70.8X
20X Ramsden	13.2	20X	10.4	34.0X	7.3	68.8X	5.0	70.8X
15X Ramsden	13.2	15X	10.4	25.5X	7.3	51.6X	5.0	53.6X
6X Huyghenian	13.2	6X	10.4	17.0X	7.3	34.4X	5.0	35.4X
10X Huyghenian	13.2	10X	10.4	17.0X	7.3	34.4X	5.0	35.4X

EYEPieces	1.0X Objective		1.7X Objective		2.3X Objective		3.4X Objective		4.8X Objective	
	Field of view in mm.	Magn.	Field of view in mm.	Magn.	Field of view in mm.	Magn.	Field of view in mm.	Magn.	Field of view in mm.	Magn.
10X Wide Field	13.2	10X	10.4	17.0X	7.3	22.9X	5.3	34.4X	3.6	40.0X
5X Wide Field	13.2	20X	10.4	34.0X	6.9	34.4X	4.6	51.6X	3.2	73.5X
20X Wide Field	11.9	22.6X	8.4	34.6X	5.8	45.8X	3.8	68.8X	2.7	94.0X
6X Ramsden	16.0	6.8X	11.4	9.5X	7.9	13.7X	5.3	26.6X	3.7	29.4X
15X Ramsden	13.2	15X	10.4	15.2X	7.3	20.4X	5.3	34.4X	3.0	40.0X
5X Ramsden	13.9	17.0X	9.7	23.7X	6.7	34.9X	4.5	51.6X	3.1	73.1X
6X Huyghenian	17.2	6.8X	12.3	9.5X	8.7	13.7X	5.6	20.6X	4.0	29.4X
10X Huyghenian	12.8	11.1X	9.2	15.9X	6.4	22.9X	4.3	34.3X	3.0	49.6X

## Accessories

### for Spencer Junior Stereoscopic Microscope

#### Paired Objectives

Cat. No.	Description	Price
285	1.0X Paired Objectives	
286	1.7X Paired Objectives	
288	2.3X Paired Objectives	
289	3.4X Paired Objectives	
290	4.8X Paired Objectives	
291	6.8X Paired Objectives	
293	One A 1.0X and 2.3X Paired Objectives	
387	One C 1.7X and 3.4X Paired Objectives included in revolving tubum	

#### Paired Eyepieces

Cat. No.	Description	Price
1.38	6X Paired Huyghenian Eyepieces	
1.41	10X Paired Huyghenian Eyepieces	
1.47	6X Paired Ramsden Eyepieces	
1.79	15X Paired Ramsden Eyepieces	
1.35	10X Paired Wide Field Eyepieces	
1.37	4X Paired Wide Field Eyepieces	
1.39	20X Paired Wide Field Eyepieces	
Note: All of the above eyepieces accommodate micro-meter discs and reticles which are 21.5mm dia.		

#### Miscellaneous Accessories

Cat. No.	Description	Price
399	Glass Stage Plate for No. 37 and 67	
437	Bracket for attaching No. 353 Lamp to body tube	

#### Cabinets

Cat. No.	Description	Price
65	Cabinet for No. 67 and No. 77	
637	Cabinet for No. 37	



# Spencer Metallurgical Microscopes

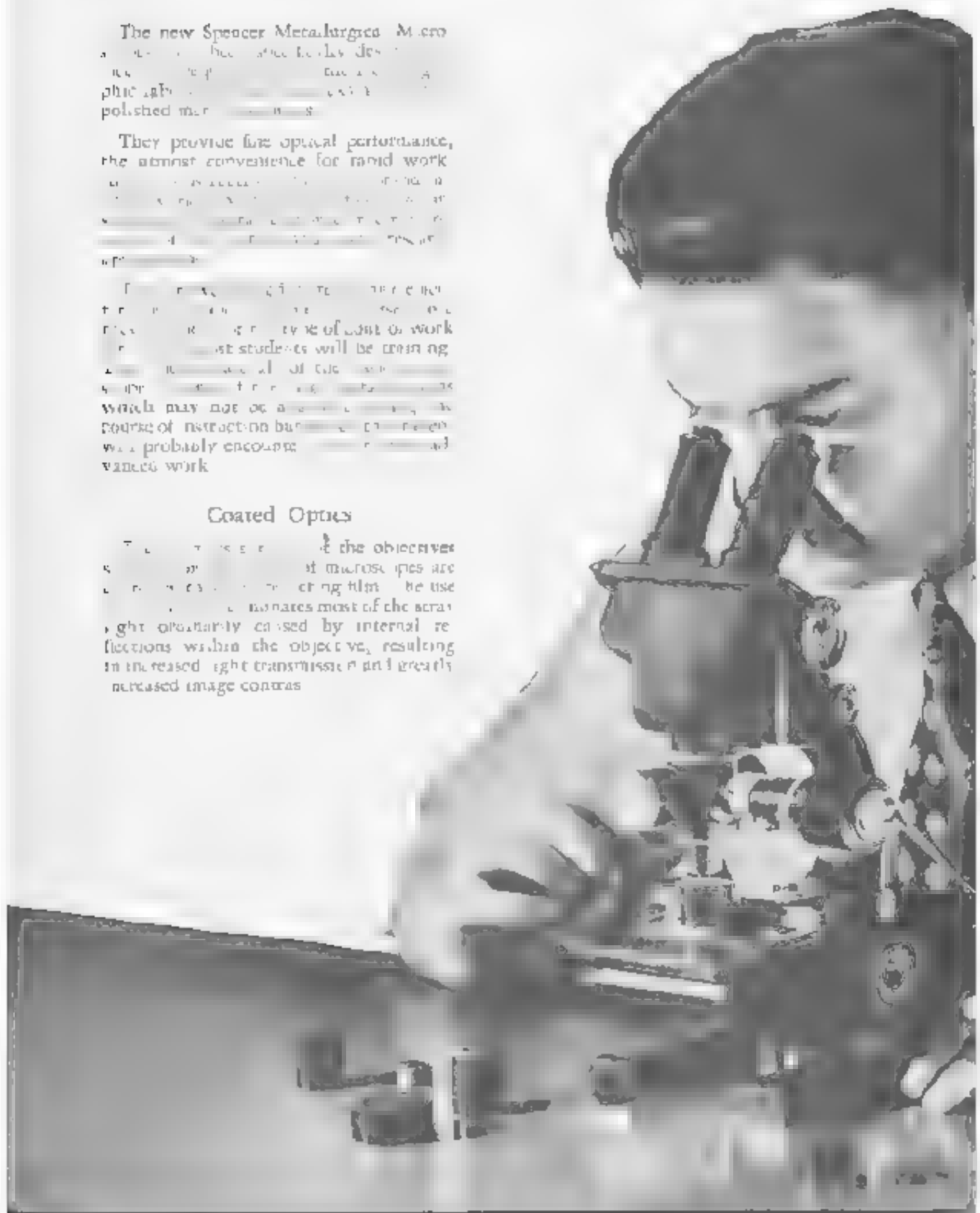
The new Spencer Metallurgical Microscopes have been specially designed for the study of polished metal surfaces. They provide fine optical performance, the utmost convenience for rapid work and the ability to handle large specimens.

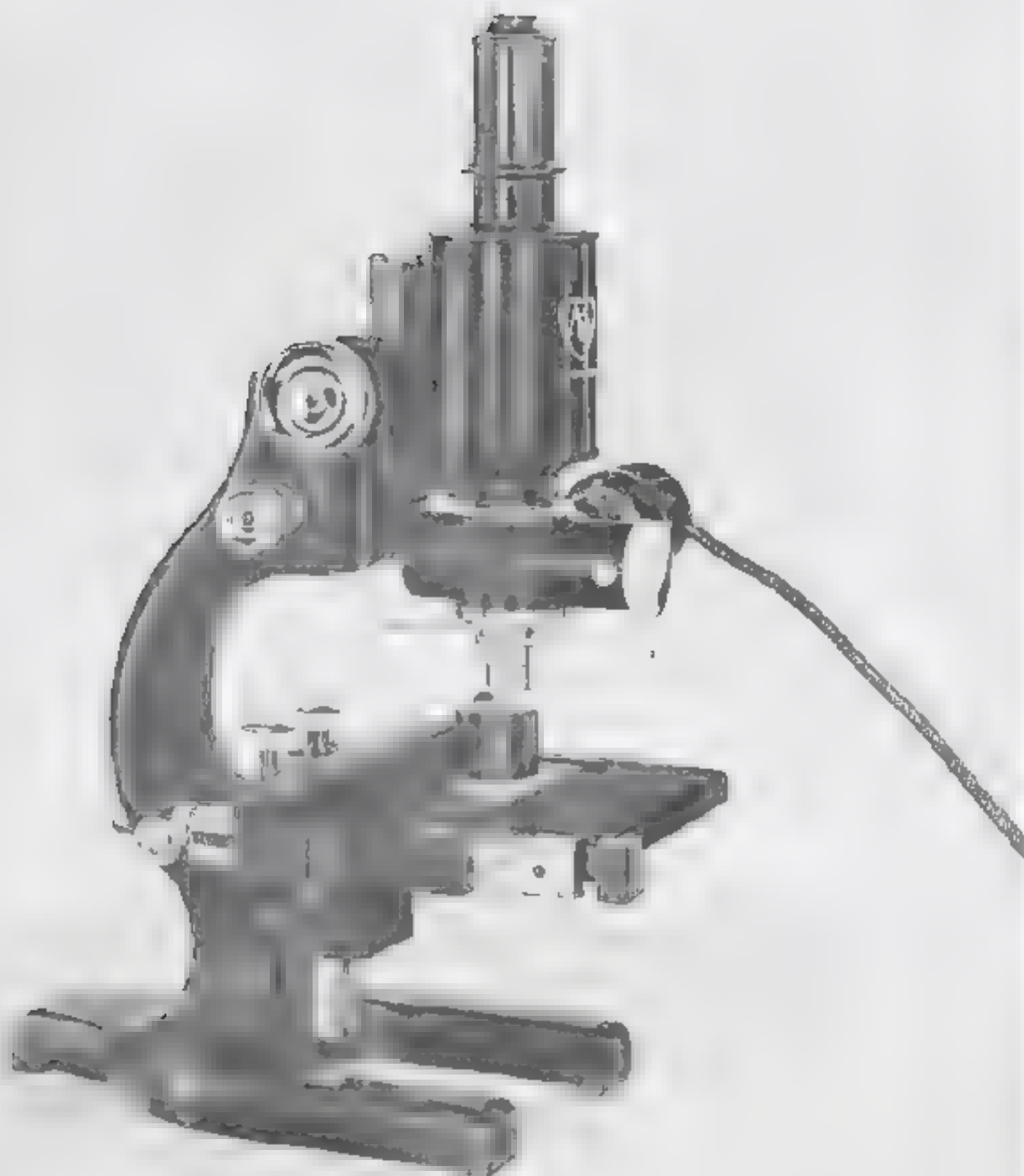
They provide fine optical performance, the utmost convenience for rapid work and the ability to handle large specimens. The design is such that the microscope can be used in a variety of positions, and the eyepiece can be tilted to suit the observer's eye.

The microscope is designed to be used in a variety of positions, and the eyepiece can be tilted to suit the observer's eye. It is particularly suitable for use in the laboratory, where it can be used to study the structure of metals and alloys. The microscope is also suitable for use in the field, where it can be used to study the structure of metals and alloys in situ.

## Coated Optics

The objectives of the microscope are coated with a thin layer of silver. This coating is applied by a special process which ensures that most of the stray light ordinarily caused by internal reflections within the objective is eliminated, resulting in increased light transmission and greatly increased image contrast.







## Vertical Illuminator

The newly designed Spencer Vertical Illuminator is the result of studies of past instruments and new scientific developments. Adjustments have been kept to a minimum without sacrificing good performance. The Vertical Illuminator is attached to the microscope stand in a position which allows the operator to make the necessary adjustments conveniently with manipulations divided between the left and right hands.

### Field and Aperture Diaphragms

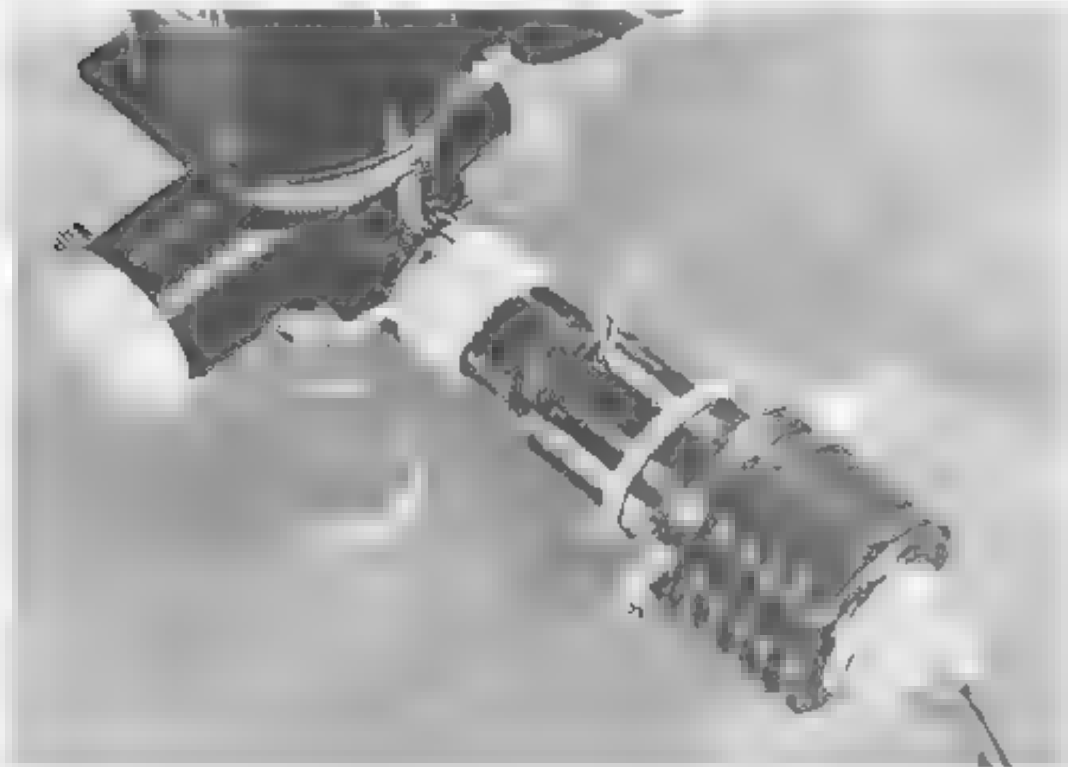
To eliminate unnecessary glare and obtain maximum contrast, a field diaphragm is provided which restricts the area of specimen illuminated to correspond with the field covered by the objective-eyepiece combination. An aperture diaphragm provides regulation of numerical aperture for best results with each objective.

### Prism and Coated Reflector

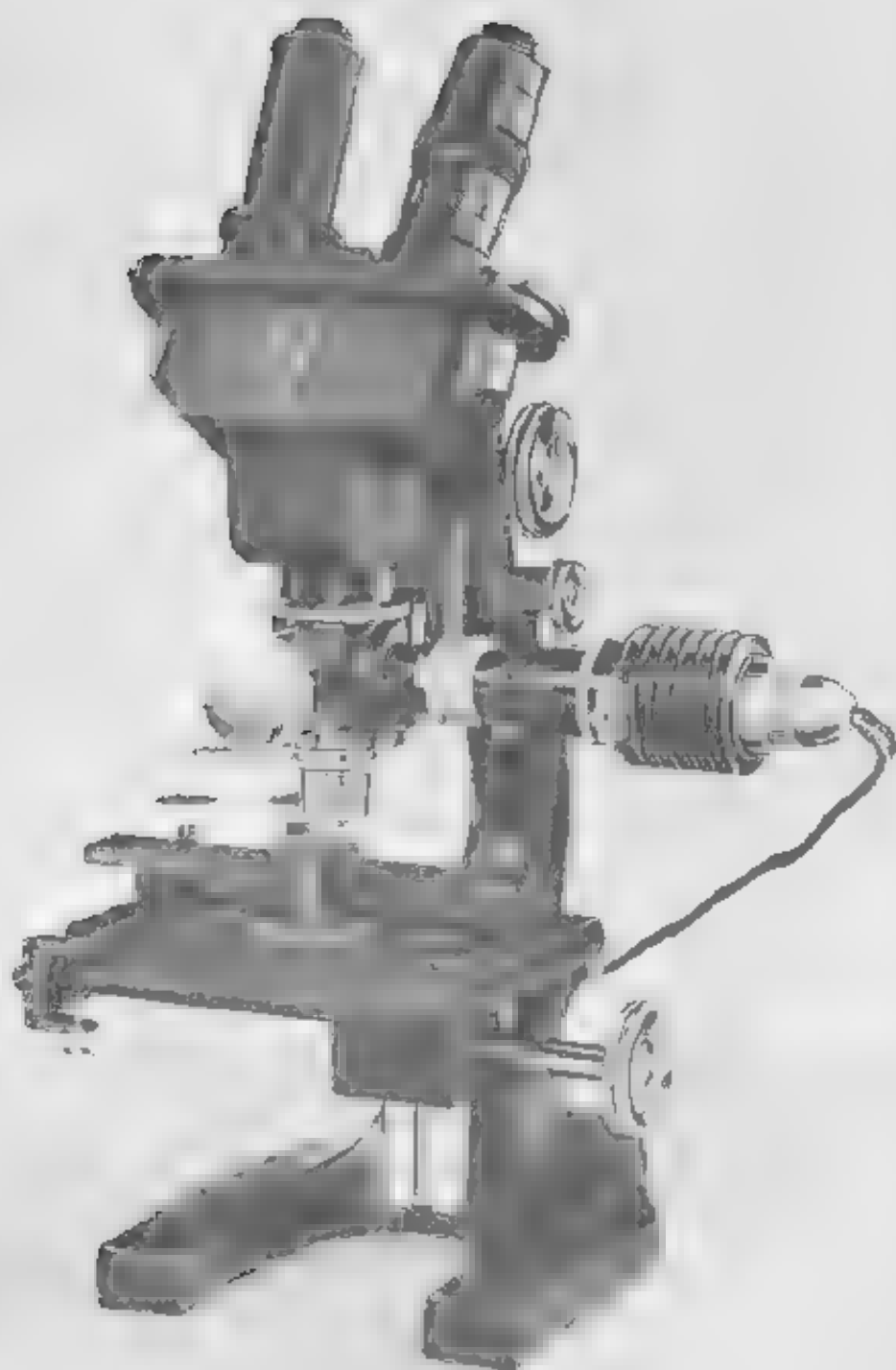
The light is directed down through the objective by means of a plano-reflector or prism. These are mounted on a horizontal bearing so that either the prism or the reflector can be brought into operating position by sliding the bearing to one of two definite positions. The prism and plano-reflector can be removed readily for cleaning.

Since the image-forming rays must pass through the plano-glass reflector after passing through the objective, it is made with the same degree of precision as the optical elements in the microscope objective. Its surfaces are optically flat and parallel. These reflectors are inspected individually with an interferometer to meet exacting optical specifications.

Both surfaces of the plano-reflector are coated. One surface is coated with a high reflecting film to concentrate a maximum amount of light on the specimen. The



Vertical Illuminator assembly with Illuminating Unit





inner surface is coated with a low reflecting film to transmit the light which would otherwise be reflected from the second surface. This increases the illumination and eliminates the double image of the field diaphragm. This is a unique Spencer feature based on techniques developed by our research scientists. The Vertical Illuminator is offered for student use with an anti-coated reflector.

### Illuminating Unit

An efficient, compact, illuminating unit which is designed to attach to the Vertical Illuminator provides a complete permanently aligned optical system with an integral light source.

The source is a concentrated filament, low voltage, low wattage bulb of high intensity, giving off a minimum amount of heat. Current supplied by a transformer or resistance from a 110 volt 60 cycle alternating or direct current line. The lamp housing remains remarkably cool due to the low wattage of the bulb and the efficient design of the lamp house employing fins for heat radiation. The bulb can be centered quickly, and locked in position. This adjustment need not be changed during the life of the bulb.

Because of the high efficiency of the optical system ample illumination is obtained for visual work at the highest magnification, even when using the binocular body. The Spencer Vertical Illuminator is designed to yield uniform illumination at all magnifications.

The light intensity can be changed quickly by a slide in the illuminating unit. In one position maximum illumination is provided for use with binocular microscopes; the other position reduces the illumination to a comfortable level for monocular observation.

The illuminating unit is easily removed so that the microscope may be used with

a light source of higher intensity for photomicrography.

### Filters

Filters are available, readily interchangeable, and locked in place in a positive manner. A green filter with a spectral distribution which corresponds to the most favorable color correction of the optical system, is included as standard equipment. A blue filter is available which gives light of near day light quality and is recommended for identification of non-metallic inclusions.

A polarizer filter and cap analyzer are available for studies of non-metallic inclusions and other work in polarized light.

### Nosepiece

Objectives are changed in a positive and convenient manner. Each objective is mounted in an adapter with a handle which is instantly attached to the quick-change nosepiece on the Vertical Illuminator.

The quick-change nosepiece and adapter together, require very little space. Thus, full advantage is taken of the short objective mount designed to bring the rear focal plane of the objective as close as possible to the reflecting element of the eyepiece.

## General Specifications

Five different microscopes are offered—Monocular Microscopes Nos. 46, 47 and 48 and Binocular Microscopes Nos. 50 and 51. Following are outstanding features.

### STAND

The stand has a forged brass arm with a standard taper axle inclination joint, and a heavy cast base that insures stability in all positions.



Rack and pinion method of changing obj.

#### RACK AND PINION COARSE ADJUSTMENT

This adjustment has a diagonally cut rack and spiral pinion of involute tooth design.

#### MONOCULAR BODY COARSE AND FINE ADJUSTMENT

The fine adjustment, graduated in 0.5 micron intervals, automatically compensates for wear and ceases to function when the objective contacts the specimen. All except No. 48 have a means of compensating for difference of weight between monocular and binocular body.

#### MONOCULAR BODY TUBE

The body tube has a length of 180mm. when used with the Vertical Illuminator it has an adjustable draw tube with graduations, to facilitate the instrument for making grain size and case depth measurements. The No. 48 stand is equipped only with fixed monocular tube.

#### MONOCULAR BODIES

Microscopes Nos. 50 and 51 are furnished with either the inclined or vertical binocular body. They relieve eyestrain and provide maximum comfort during long periods of observation. The eyepieces are adjusted quickly to exact inter-pupillary distance by turning a knurled ring on the right eyepiece tube. An adjustable collar on the left eyepiece tube provides a focusing adjustment to compensate for near or far vision of the observer.

An exclusive feature is the eight degree convergence angle for normal visual work.

The inclined binocular body permits a comfortable posture. Eyes, neck and shoulders are in a normal resting position. Muscles do not become tired, enabling the observer to work more efficiently.

#### STAGE

The solid, durable Bakelite stage 108mm. X 170mm., with a distance of 105mm. from arm to optical axis, is suitable to all common reagents and will not warp or fade. It is provided with chromium plated spring steel clips. Microscopes Nos. 46 and 50 have stages without circular opening. Nos. 47, 48 and 51 have a circular opening in the center for transmitted light. Mechanical stages Nos. 484 and 485, operated by the right hand in a normal, comfortable position are recommended as an aid to convenient and thorough inspection of the specimen. The entire stage (except on No. 48) is focusable by rack and pinion to a distance to locate large specimens. When using a more intense light source for photomicrography the stage can be raised and lowered by its rack and pinion adjustment instead of using the coarse adjustment on the body tube. Thus it is not necessary to disturb the alignment of the lamp and Vertical Illuminator when changing objectives or specimens.



The stage of Nos. 46, 47, 50, and 51 is rigidly supported by a horseshoe type bracket to insure freedom from vibration.

## OPTICS

Standard magnifications of 75X, 100X, 200X, 500X, 1000X and 1500X are provided with proper combinations of eyepieces and objectives. Eyepieces are truncated cone shape for ease of observation—especially desirable for those wearing glasses. Lenses are easily cleaned. Objectives are standard Spencer achromatic type designed for finest performance with the Spencer Metallurgical Microscope.

The special micrometer eyepiece No. 2513 is for making measurements directly in thousandths of an inch and is recommended for case depth, and other linear measurements. For measurement of thickness of electroplating we recommend a Screw Micrometer Eyepiece No. 425.

## FINISH

The finish is baked black enamel and chromium plating.

## CABINET

The Metallurgical Microscope is furnished in a leatherette covered heavy wood cabinet. The cabinet for all stands except the No. 48 is furnished with a drawer in the upper part of the cabinet for storage of objectives, eyepieces and other accessories. The cabinet for the No. 48 has a slot to hold additional objectives and eyepieces.

## Microscopes Nos. 47 and 51

Spencer Metallurgical Microscope No. 47 is the same as No. 46 but has a stage with a center opening and is equipped with a substage condenser N.A. 1.25 and mirror

for use with transmitted light. Microscope No. 51 is equipped with binocular body and substage equipment for transmitted light.

## Microscope No. 48

Spencer Metallurgical Microscope No. 48 is similar to No. 46 and No. 47 but does not have a rack and pinion focusing stage and cannot be equipped with the binocular bodies. There is a wide range of coarse adjustment for use at all magnifications with average size specimens. The No. 48 microscope is adequate for most types of routine visual work and is very satisfactory as a teaching instrument.

## In Placing Your Order, Follow These Instructions:

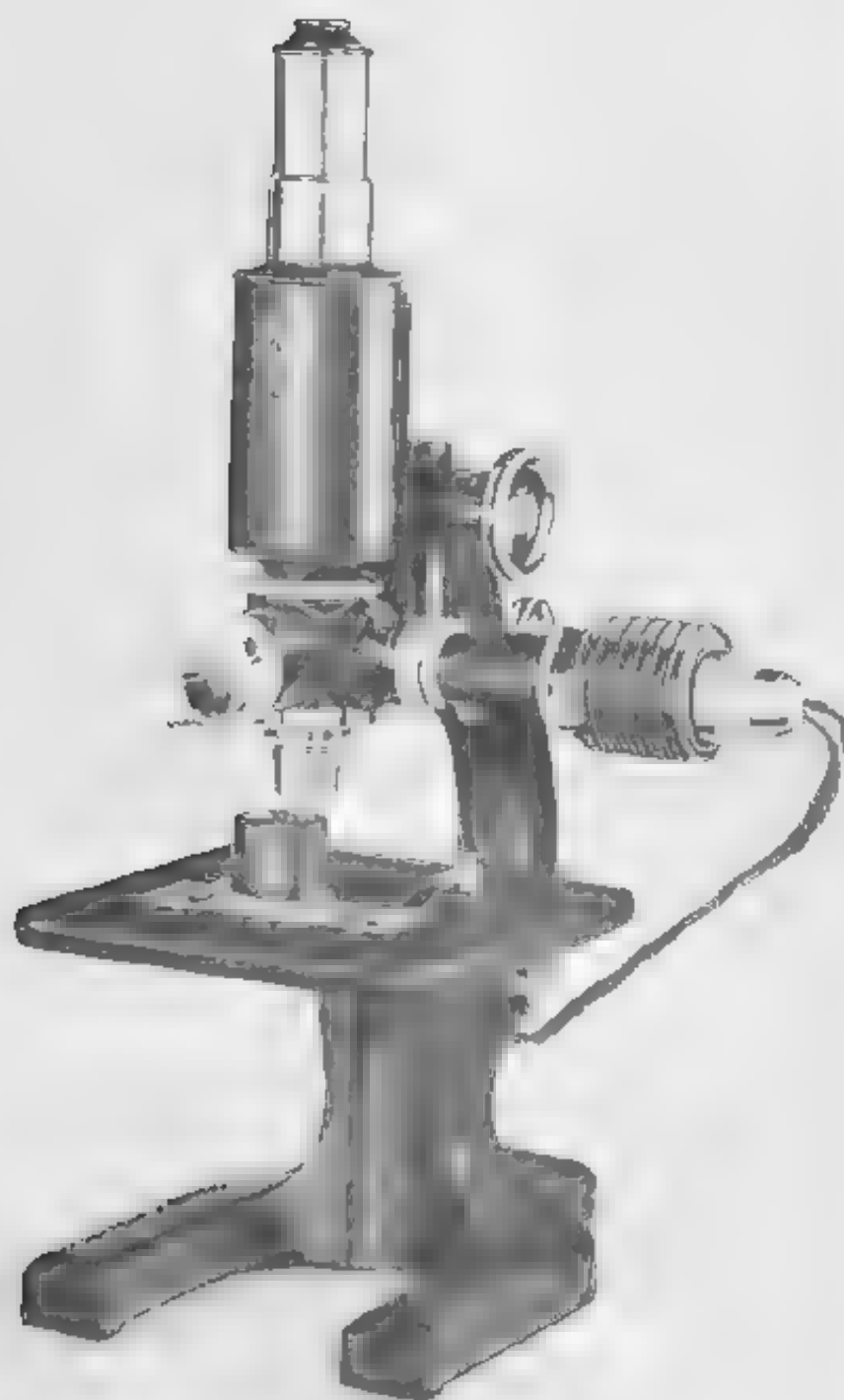
Use the chart on page 9 to select the features and accessory equipment required. Order by catalog number and further description, if necessary.

Substitutions from standard catalog numbers shown on the chart can be made from the complete listing of objectives and eyepieces, together with the list of accessories.

The following notes may be helpful in making substitutions not readily found in these listings of accessory equipment:

1. The No. 485 Graduated Mechanical Stage, suitable for making measurements and locating areas within the specimen, can be substituted for the No. 484 Ungraduated Mechanical Stage. Add
2. Uncoated reflector in vertical illuminator can be substituted for the coated reflector. Deduct
3. Vertical binocular body can be substituted for standard binocular on Nos. 50 and 51. Deduct
4. If fixed monocular tube is desired instead of adjustable. Deduct







Car No.	Stage	Body Tube	Vertical Illuminator	Chromatic Objective	Eye-pieces	Sub-stage Condenser	Magnification (Approx.)	P
46A	Solid, focussable	Adjustable Monocular	Complete with coated reflector, variable trans-former, 2 objective adapters.	6mm. 4mm.	12X Huyghenian	None	100X 500X	
46MB	Solid, focussable with No. 484 Stage	Adjustable Monocular	Complete with coated reflector, variable trans-former, 3 objective adapters.	3.5X 6mm.	8X Huyghenian	None	25X 75X 300X	
46MC	Solid, focussable Mechanical Stage	Adjustable Monocular	Complete with illuminating unit, variable trans-former, 3 objective adapters.	16mm. 4mm.	6X Huyghenian 12X Huyghenian	None	50X 200X 500X	
47MD	Stage with center hole, No. 484 Mechanical Stage	Adjustable	Complete with illuminating unit, variable trans-former, 5 objective adapters.	3.5X 8mm. 4mm. 18mm.	8X Huyghenian 12X Huyghenian 15X Comp.	Abbe with mirror	25X 100X 200X 500X 1000X 1500X	
48A	Solid, focussable	Fixed Monocular	Complete with uncoated plane-reflector, illuminating unit, fixed transformer, 2 objective adapters.	16mm. 4mm.	12X Huyghenian	None	100X 500X	
48MB	Stage with center hole, No. 484 Mechanical Stage	Fixed	Complete with illuminating unit, fixed transformer, 3 objective adapters.	3.5X 4mm.	8X Huyghenian	None	25X 500X	
50MB	Solid, focussable with No. 484 Mechanical Stage	Inclined Binocular	Complete with coated reflector, illuminating unit, variable trans-former, 3 objective adapters.	5.5X 6mm. 4mm.	Pair of 8X Huyghenian 12X Huyghenian	None	25X 75X 100X 500X	
50MC	Solid, focussable with No. 484	Inclined Binocular	Complete with coated reflector, illuminating unit, variable trans-former, 3 objective adapters.	16mm. 8mm.	Paired 6X Huyghenian	None	50X 200X 500X	
50MD	Solid, focussable	Inclined Binocular	Complete with coated reflector, illuminating unit, variable trans-former, 5 objective adapters.	3.5X 16mm. 4mm.	Paired 8X Huyghenian 15X Comp.	None	25X 75X 100X 500X 1000X 500X	
51M	Solid, focussable with center hole, No. 484 Mechanical Stage	Binocular	Complete with coated reflector, illuminating unit, variable trans-former, 5 objective adapters.	6mm. 18mm.	8X Huyghenian 15X Comp.	N.A. Mirror	75X 100X 500X 1000X 500X	



## HUGHENIAN EYEPIECES

## COMPENSATING EYEPIECES

Cat. No.	Mag.	Cat. No.	Mag.
136	6X	167 (High Eyepiece)	10X
140	8X	168	10X
142	10X	170	15X
144	12X	1167 (Paired High Eyepiece)	10X
1139 (Paired)	6X	1168 (Paired)	10X
1140 (Paired)	8X	1170 (Paired)	15X
1142 (Paired)	10X		
1144 (Paired)	12X		

## ACHROMATIC OBJECTIVES—SHORT MOUNT FOR USE WITH VERTICAL ILLUMINATOR

Cat. No.	Focal Length	Mag.	Price
O2	40mm.	4X	
O4	37mm.	4X	
C O5	30.2mm.	5X	
O7	24mm.	6X	
C1749	6mm.	10X	
C1753	8mm.	12X	
C1759	4mm.	15X	
C1764	1.5mm. (oil immersion)	100X	

NOTE: Objective Adapter No. 25, necessary for use on Vertical Illuminator. One furnished with 2330, 2540.

## VERTICAL ILLUMINATOR AND ACCESSORIES

Cat. No.	Description	Price
2530	Vertical Illuminator with coated reflector, prism, quickchange mechanism, glass filter, without illuminating unit, with leatherette case	
2540	Vertical Illuminator same as above but with enclosed illuminating unit	
2506	Fixed Transformer for use with No. 2505 on 110 volts A.C.	
2505	Variable Transformer for use with No. 2504 on 110 volts A.C.	
2508	Fixed Resistor for use with No. 2505 on 110 volts D.C.	
2510	Quick-Change Objective Adapter	
2512	Blue Light Filter in metal housing	
2515	Micrometer Eyepiece to read 0.0001 inch with 6mm. objective	
2517	Leatherette Case for vertical illuminator and accessories	
425	Screw Micrometer Eyepiece	

## REPLACEMENT PARTS

2501	Coated Plano-Glass Reflector as supplied with No. 2540	
2502	Spec. Coated Plano-Glass Reflector as supplied with No. 2530	
2509	Bulb, E volt, 0.6 amp. for No. 2505	
2518	Protective Glass Window (supplied with No. 2530 and 2540)	

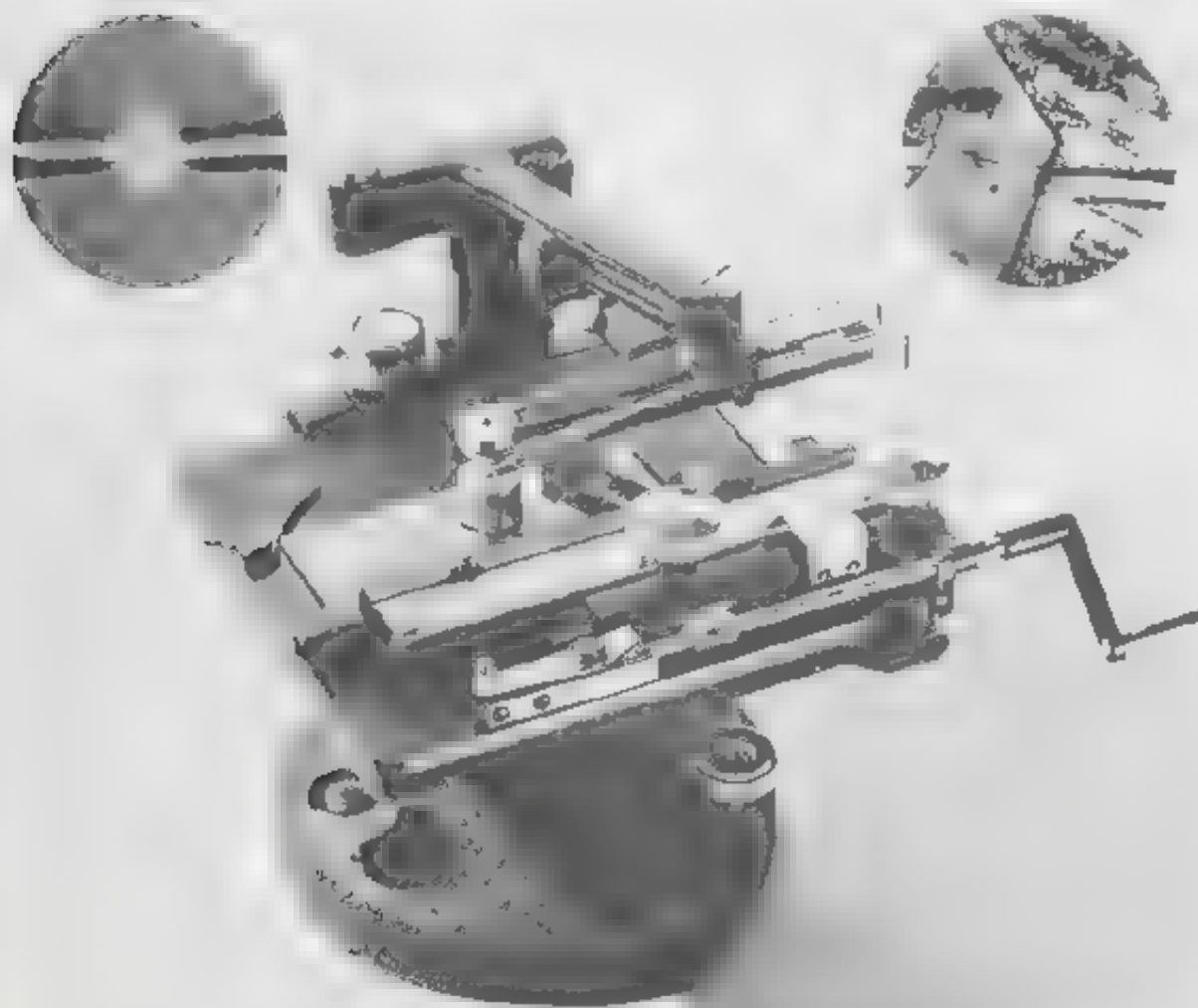


# The Spencer Bierbaum Microcharacter

The Spencer Bierbaum Microcharacter\* is an instrument designed and produced by Christopher H. Bierbaum, President and Chairman of the Bearing Metals Research Institute of the American Society of Mechanical Engineers.

Although the Microcharacter is primarily

designed to determine the hardness of the different microscopic constituents of bearing metals, it is now being used successfully on many different types of materials for the measurement of hardness of small microscopic areas and particles of various metals in many applications where



Spencer Bierbaum Microcharacter on the testing stand

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0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
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type of measurement is impossible with any other instrument. For example, the testing of electrolytically deposited chrome plate and case hardened steel has been accomplished with the Microcharacter with unique success. Its application to the rapidly expanding plastics industry is

The procedure consists of moving, with a micrometer feed, a highly polished lubricated surface of the material to be tested beneath a very accurately ground diamond point which is under a definite pressure. After a cut is made, its width is measured under the microscope and the hardness determined from a convenient formula.

The Spencer-Sierbaum Microcharacter is a precision instrument manufactured in accordance with the exacting specifications demanded by the basic principles of the microcut method to ensure accurate and reliable results.

A considerable amount of study has been devoted to the shape and proportion of a suitable cutting point, not only as to the best and most efficient for such service

enabling the duplication of the cutting point in accordance with exact specifications. The corner of a cube was finally adopted as the most desirable shape, since it can be duplicated exactly and at the same time is very durable. One of the world's outstanding diamond cutters has developed a technique of grinding specially selected diamonds for use in the Microcharacter with no flaws or inaccuracies visible under a 1000X magnification of 2000 diameters.

It is essential that the cutting point be used classically in order for it to respond to the different depths of microcut, and also that the advancement should be very slow and even so that no additional penetration is effected by stopping. In order that the width of cut shall under all conditions, be a direct function of its depth and the square of the width of cut be directly proportional to the cross-sectional area, it is necessary that the cutting point be exceedingly accurate, that the three facets be true plane surfaces, that the three lines of intersection of these three facets be straight lines, and that the point shall be exceedingly sharp. These con-

ditions are absolutely necessary in order that a rational scale of hardness may be established which will apply equally well to all degrees of hardness of the various substances tested, thereby giving an accurate means of consistent hardness determination.

The diamond is attached to a spring in such a manner that if the solid right angle or cutting point is considered as constituting one corner of an imaginary cube, the diagonal of this cube would then be normal to the test surface. One of the edges, formed by the intersection of two facets, is the advance or cutting edge, and is in direct line with the microcut. This advanced edge makes an angle of  $35.25^\circ$  with the test surface constituting the angle of inclusion. The depth of cut is always slightly less than  $4/10$  of its width; therefore, the force of indentation is always greater than that of translation.

For the most satisfactory results with the Microcharacter, it is necessary to have a good metallurgical microscope. It is particularly important to have a vertical illuminator equipped with a means for proper control of illumination and a rigid stand with a responsive fine adjustment. An oil immersion objective is necessary for the required accuracy in measuring the width of microcuts, especially so with very hard materials. For most purposes a dry objective of 4mm focal length is a so very useful for preliminary study. A screw micrometer eyepiece of high magnification not less than 15 or 25 diameters is also required.

Cat. No.	Description	Price
10002	Microcharacter complete with 3 grain rough, diamond and leveling stand	
ACCESSORIES		
10009	Replacement diamonds mounted on	
10006	Screw micrometer eyepiece with	
10006	15X compensating eyepiece for	

For best results we recommend use of the Spencer Metallurgical Microscope and Vertical Illuminator.



## Polarizing Microscopes

The Polarizing Microscope, long an indispensable aid of the petrographer, has come into its own in many branches of science in recent years. Micro techniques in chemistry, employing polarized light, have effected significant economies of time and material. The metal, petroleum, plastics, and synthetic fibers industries find this instrument of increasing importance in fundamental research and process control. The biologist has found a steadily increasing number of applications for it. The optical activity of various materials is adding daily to our knowledge of life, disease, and death.

Because of the many different uses for Spencer Polarizing Microscopes, several variations of each model are listed. Simple designations of these optional features are described in the following paragraphs.

Each microscope is available with either a rotatable or a non-rotatable analyzer in the body tube. This is indicated by the use of one of the following letters immediately after the model number:

- A Designates a Rotatable Analyzer
- B Designates a Non-Rotatable Analyzer.

Research Polarizing Microscopes are listed only with the centerable quick-change nosepiece, but Standard Polarizing Microscopes may be ordered with a non-centerable revolving nosepiece. These differences in the Standard Polarizing Microscopes are indicated by a second letter following the catalog number:

- C Designates a centerable Quick-Change Nosepiece and a non-centerable stage.
- D Designates a non-centerable Triple Revolving Nosepiece and a centerable stage.

All Spencer Polarizing Microscopes have the same type of focusing adjustments, clination joint, mirror, and finish. They are characterized by Spencer sturdiness, precision of movement, and fine appearance.

The rack and pinion coarse adjustment consists of a diagonal rack and spiral pinion. The bearing surfaces are provided with oil grooves, and different metals are

used in the two contacting surfaces to provide smooth, easily-controlled motion.

The fine adjustment, the most important mechanical feature in a microscope, as on other Spencer microscopes, consists of a micrometer screw working in conjunction with a bell-crank lever, thereby providing a degree of precision found only in the finest measuring instruments.

Since the action of the screw is applied only in moving the body tube upward, the possibility of breaking the cover glass is greatly reduced.

The inclination joint works with exceptional smoothness, yet holds the instrument at any desired angle.

All stands are provided with a 50mm. substage mirror, plane on one side and concave on the other.

The lines on all graduations are distinct and easily read.

The instruments are finished in satin black enamel, and the graduated circles, verniers, and adjustment buttons are chromium plated to resist the fumes of reagents commonly used in chemical microscopy and petrography.

### Stands

Microscopes Nos. 37 and 39 have the same heavy rigid stands, designed to meet the critical needs of the petrographer, whose work is of the most exacting nature, and are fully adapted to a wide types of microscopic research in polarized light. The stands will accommodate the largest universal stages. The top of the stage is 145mm. from the table, providing ample space for substage manipulation. The distance from the inside curve of the arm to the optical axis is 116mm. The body tube has a dovetail slide which provides 32mm. excursion in addition to the 80mm. range of movement available in the rack and pinion adjustment. The fine adjustment is graduated in units of 1 micron.

On Spencer Polarizing Microscopes Nos. 40, 41, 42, 43, a slightly smaller stand is supplied. The model numbers indicate differences in body tube and substage assembly. These are described fully in the list.

EYEPIECE

SPIRAL FOCUSING RING  
FOR AMICI BERTRAND LENS

COARSE FOCUSING ADJUSTMENT

BODY TUBE

MICROMETER TYPE  
FINE ADJUSTMENT

BODY TUBE RACK

QUICK CHANGE  
NOSEPIECE

OBJECTIVE  
CENTERING  
RING

ARM

BALL  
BEARING  
REVOLV-  
ING  
STAGE

INCLINATION  
JOINT

FORK TYPE SUBSTAGE  
MOUNTING

BASE

FOCUSING EYE LENS

ENGRAVED  
CROSS HAIR DISC

EYEPIECE FIELD LENS

AMICI BERTRAND LENS

COMPENSATING LENS

PROTECTING PLATE

AHRENS  
ANALYZING PRISM

PROTECTING PLATE

COMPENSATING LENS

OBJECTIVE LENSES

SWING OUT UPPER  
LENSES OF CONDENSER

LOWER FIXED LENSES  
OF CONDENSER

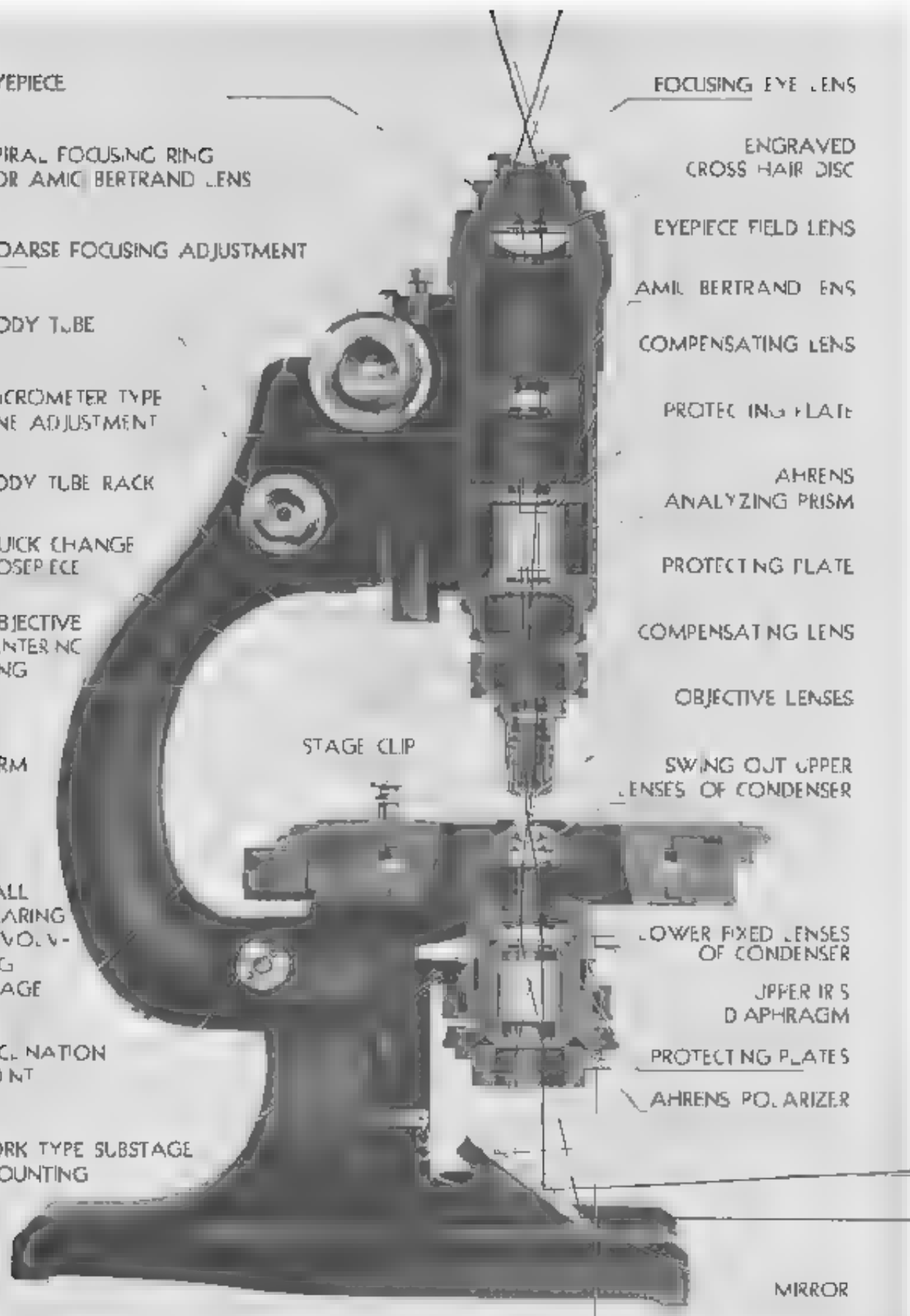
UPPER IRIS  
DIAPHRAGM

PROTECTING PLATES

AHRENS POLARIZER

MIRROR

LOWER IRIS DIAPHRAGM





ing of such a microscope. The stand is heavy and better for critical work. It will accommodate the study of universal and negative stages, and is so adaptable that, except for advanced research work, it will satisfy the requirements of the petro-

st. The distance from the optical axis to the arm is 103 mm, and the stage height is 100 mm. Body tube construction permits great latitude of adjustments for the observation of all types of material. The floor adjustment is graduated in units of 2.5

### Regular Revving Stages

The precision of the revolving stages is maintained by the use of ball bearings. The stages are free from play or creeping. The positions of the tape are given by a single degree with the vernier reading to 10 minutes.

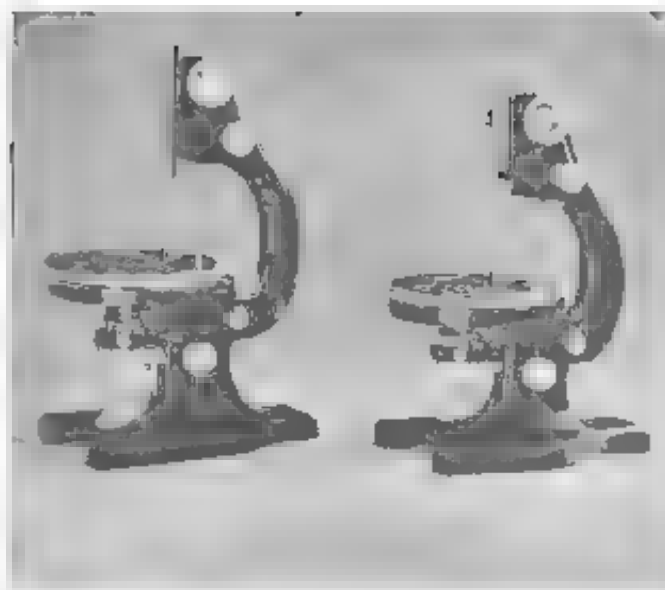
A preferable stage, with conical bearings, is supplied with a conical adjustable revolving nosepiece is ordered. On request provision is made for locking the stage at any desired position of rotation.

Two sizes of stage are used on Spencer Potting Microscopes. Microscopes Nos. 40, 41, 42, and 43 are equipped with a plain bearing stage, either centerable or non-centerable, which is .25mm in diameter. Microscopes Nos. 37 and 39 are equipped with a non-centerable, ball-bearing stage .50mm in diameter. A slow motion adjustment will be supplied with the ball-bearing stage at a slight additional cost. The stages are drilled and tapped to accommodate universal slits. In addition to the No. 495 Mechanical Stage.

## Crystal Optics

The Ahrens prism has long been accepted as the most satisfactory means for polarizing light. The best quality calcare prisms

*Spinica Lincolne* R. & L. Long Sea



The author stands for all Participating Members.

are used in Spencer Research Nos. 37 and 39) and Standard Nos. 40 and 41. Possessing Microscopes. Improvements in mounting and mounting methods developed by

New opportunities in the design of optical instruments have been presented by the discovery of new materials. The use of glass, of crystal and polarizing materials and in the development of new plastics is the result of American Optical Company who have been testing these materials for several years have enjoyed splendid success.

The Spencer Super High Polarizing Microscopes (Nos. 41 and 43) employ these new materials. These instruments use polarizers of the most advanced type Polaroid material. Outstanding photographers have examined these materials under adverse conditions. Thorough tests indicate that polarizers of these materials under adverse conditions. They were found to resist vapors and fumes in concentrations far beyond what can be tolerated by the user. Heat resistance has also been carefully investigated and it has been shown that the







materials are unaffected by temperatures well in excess of the limits of observation. (Note: As with calcite prisms, focusing a concentrated light source in the plane of the polarizer should be avoided.)

The optical characteristics of the Spencer Polarizing Microscope are comparable to those of the best parallel glass plate equipment. The Spencer Polarizing Microscope is remarkable for its freedom from residual color. Furthermore the shorter length of the instrument results in a minimum of stray light. A noticeable increase in the image results. This is particularly important in the added crispness appearing in interference figures.

Spencer research, in cooperation with the plastics industry, has also developed retardation plates for determining the rate of double refraction. Careful control of temperature and resistant to flames. The manufacturing process used to produce these plates is capable of more accurate control than can be achieved through the chemical process. A quartz wedge, designed to give a zero order, is also available. See following pages for listing of these accessories.

### Body Tubes

The body tube on all Spencer Polarizing Microscopes are exceptionally large.

Devoted always for at least one purpose. Small knurled heads are located at both ends of the sliding parts so that they may be operated with either hand.

All body tubes, of which there are four, are supplied with a built-in body tube. Two are equipped with 12 in. l. i. and 12 in. l. i. analyzers and accommodates standard diameter lenses. The other two are equipped with high grade rotatable lenses and accommodate standard diameter lenses. The lenses are either a fixed front or a rotatable one having graduations from 0° to 90°. The terminal positions of this range are indicated by a dial; however, an additional range is available beyond the 0° and 90° positions.

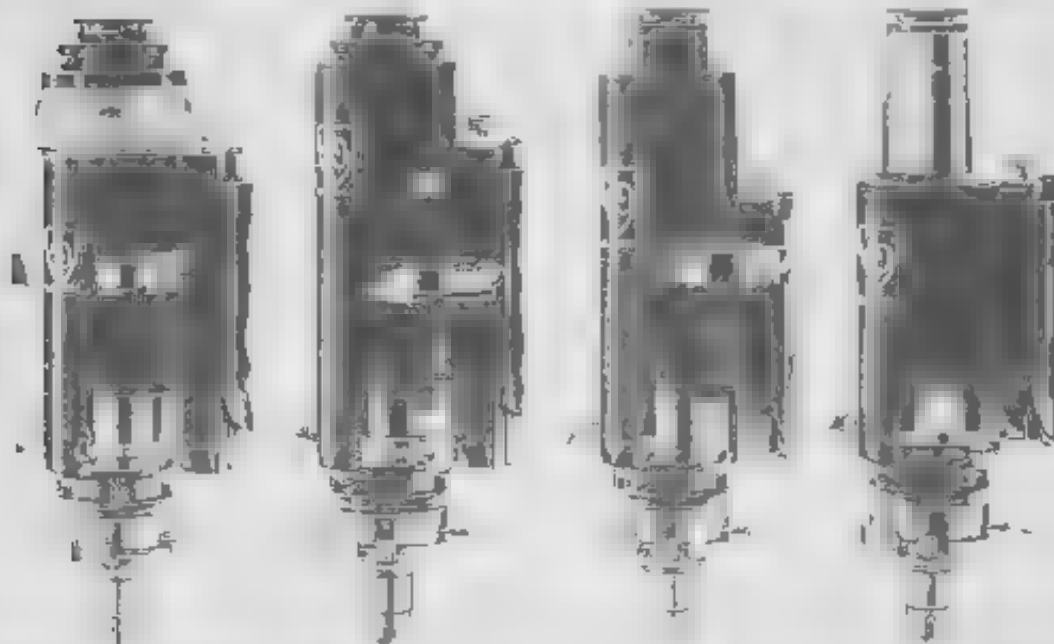
Focusable Amici Bertrand lenses are available in the two body tubes having Amici prism analyzers. In these body tubes the Bertrand lens is centerable in its mount and is equipped with an iris diaphragm.

The spiral focusing Bertrand lens, as supplied on the body tube for the Nos. 37 and 40 Microscopes, is actuated by a graduated knurled ring at the top of the body tube.

The hand sliding focusing Bertrand lens, as supplied on the body tubes of the Nos. 39 and 41 is focused by means of a knob extending from a slot in the side of the body tube.

Body tubes (left)

40 Nos. 36 and 41 No. 42 No. 43





Body tubes having Polaroid analyzers are available with a fixed focus Amici Bertrand lens, adjusted at the factory, as offered on the No. 42 Microscope, or with out Bertrand lens, as offered on the No. 43 Microscope. The fixed focus Bertrand lens is precentered at the factory and is not equipped with an iris diaphragm.

### Quick-Change Nosepiece

The Spencer Quick-Change Centering Nosepiece is a revolutionary new quick-change equipment consists of two parts: the nosepiece, which remains permanently attached to the objective centering ring, to which the objective is attached. The nosepiece has an ingenious spring clamp for holding the objective in positive alignment by applying tension to the objective centering rings. The convenient lever releases the objective for revolving or replacing objectives. Each objective should be equipped with an objective ring and carefully centered for subsequent use. Two keys are supplied for turning the centering screws. At the most critical centering of objectives is not essential, a revolving nosepiece is a real convenience and time saver. The Nos. 40, 41, 42, and 43 Microscopes are listed with revolving nosepieces as well as with the quick change. A centerable stage is provided when the non-centerable revolving nosepiece is supplied. The revolving nosepiece is not recommended for use on the research stands, Nos. 37 and 39, and a

centerable stage is not available on these models.

### Substage Equipment for Polarizing Microscopes

Because of the construction of the Spencer substage equipment and the method of attaching it to the microscope, this equipment may be used in a variety of ways. For example, the condenser may be used without the polarizer; the polarizer may be used without the condenser; the lower fixed lens may be used entirely alone, or the entire substage may be removed easily from the fork-way support. There are two general types of substage equipment for Spencer Polarizing Microscopes.

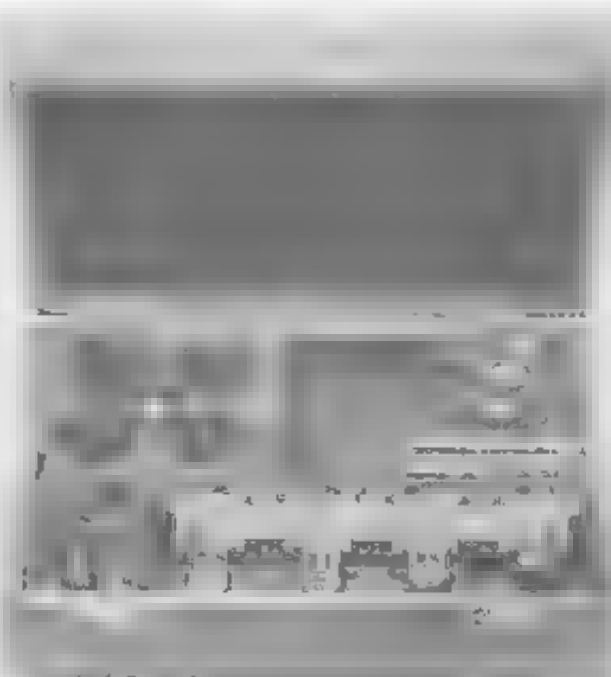
**Biological Style.** This type of condenser has been designed so that the source of illumination, when placed at a distance of approximately 10 inches from the substage mirror, is focused on the object.

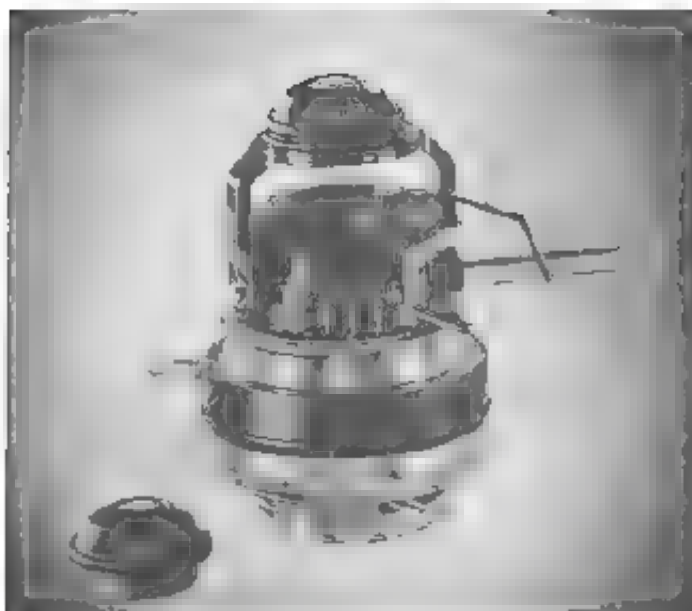
**Petrographical Style.** This type represents the more conventional form of petrographic substage condenser. Instead of the light source, either the lower iris diaphragm or the lower face of the polarizing prism (in case no lower iris is used) is focused on the specimen. In using this equipment, the concave side of the substage mirror is used to condense the light from the source at the position of the lower iris diaphragm.

Spencer quick-change nosepiece and objective centering rings

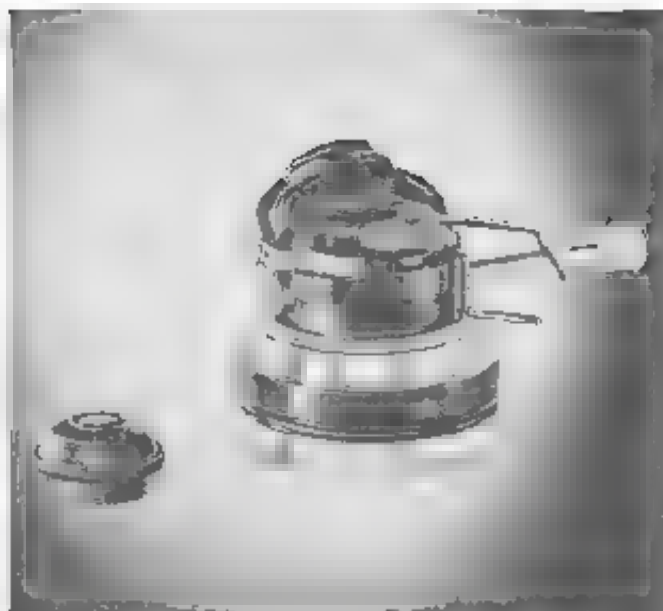


The Spencer fork-way case—standard equipment with all





*Substage Condenser No. 532, standard type present on No. 37  
It can also be used on No. 39*



*Substage Condenser No. 530 with swing-out unit tilted*

**Becke Line:** A shutter is provided on each condenser for Becke Line effect.

**Catalog No. 532:** This substage equipment (Petrographical Style), which is standard equipment on the No. 37 and which may also be used on the No. 39, has a five-lens condensing system with a numerical aperture of 1.40. The entire system is achromatic. The three-lens swing-out unit may be replaced by a unit providing a numerical aperture of 1.0.

When only the lower fixed unit of the condensing system is used, a numerical aperture of 0.28 is provided. This lower unit is fully achromatic. The condenser is equipped with both upper and lower iris diaphragms. A feature of this condenser is that the lower iris may be locked at any desired opening by means of a lock screw. A 15 millimeter Ahrens polarizer is used.

**Catalog No. 530:** This substage equipment (Petrographical Style) is standard equipment for the Nos. 39, 40, and 41 Microscopes. It is a three-lens combination with a numerical aperture of 1.0. When the two upper lenses are swung out as a unit, the lower fixed lens provides a numerical aperture of 0.28. An upper condenser unit having sufficient numerical aperture

for use with the oil immersion objective is available. It replaces the N.A. 1.0 swing-out unit in the stirrup mount. If a lower iris diaphragm is desired, No. 526 is used. The polarizing prism is a 12 millimeter

**Catalog No. 533:** This substage equipment (Petrographical Style), which is standard equipment on Nos. 42 and 43 Microscopes, is a three-lens combination with a numerical aperture of 1.0. Optically it is identical with the No. 530 Condenser, except that Polaroid is used as a polarizer instead of a calcite prism.

**Catalog No. 528:** This substage equipment (Biological Style) is designed for use on the Nos. 37 and 39 Microscopes. The condenser consists of a six lens system having a numerical aperture of 1.30. It is suitable for use with most oil immersion objectives. The condenser is applanatic and fully achromatic. The upper three-lens unit is mounted in a stirrup support which permits swinging it in and out of the path of light. When only the lower fixed lens system is used, a numerical aperture of 0.28 is provided. The mechanical equipment includes both upper and lower iris diaphragms. The three-lens, swing-out unit may be replaced by a unit providing a

numerical aperture of 1.0, which is also supplied. A 15 millimeter Ahrens polarizing prism is used. This unit may be ordered in place of the No. 532 if desired.

**Catalog No. 529:** This substage equipment (Biological Style), which may be used with the Nos. 39, 40, and 41 Polarizing Microscopes, has a numerical aperture of 1.0. It has a three-lens condenser with the two upper lenses as a unit, mounted on a strap, which can be swung out of the optical axis. The fixed lower lens has a numerical aperture of 0.78.

The condenser is regularly provided with an iris diaphragm located between the condenser and the polarizer. A second iris diaphragm, placed below the polarizer, is available as optional equipment. A 12 millimeter Ahrens polarizing prism is used. This unit may be ordered in place of No. 530 when desired.

## Optical Parts

The objectives and eyepieces for Polarizing Microscopes, like other Spencer optical parts, are carefully computed to give the finest results in the work for which they are intended. Long experience in manufacturing, the most modern and efficient equipment, and the skill of experienced workmen are combined to produce the finest optical parts for work with polarized light.

Each element in a Spencer objective is carefully mounted and centered in its cell. The elements are permanently secured at precise distances from each other in one straight line, which is a guarantee of the highest optical quality.

For achromatic objectives, those for use with Polarizing Microscopes must be mounted strain-free. Each objective is plainly marked with its initial magnification. The strain-free objectives listed for Polarizing Microscopes are corrected for use with an 0.18mm. cover glass and 166.4mm. tube length (see pages of accessories for listing of objectives, eyepieces, and accessories).

Compensators of high optical quality are available for studying the nature of birefringence. These compensators are mounted

on metal plates which form a slot in the body tube. All Spencer Polarizing Microscopes are furnished with compensators in proper relation to the polarizer and analyzer.

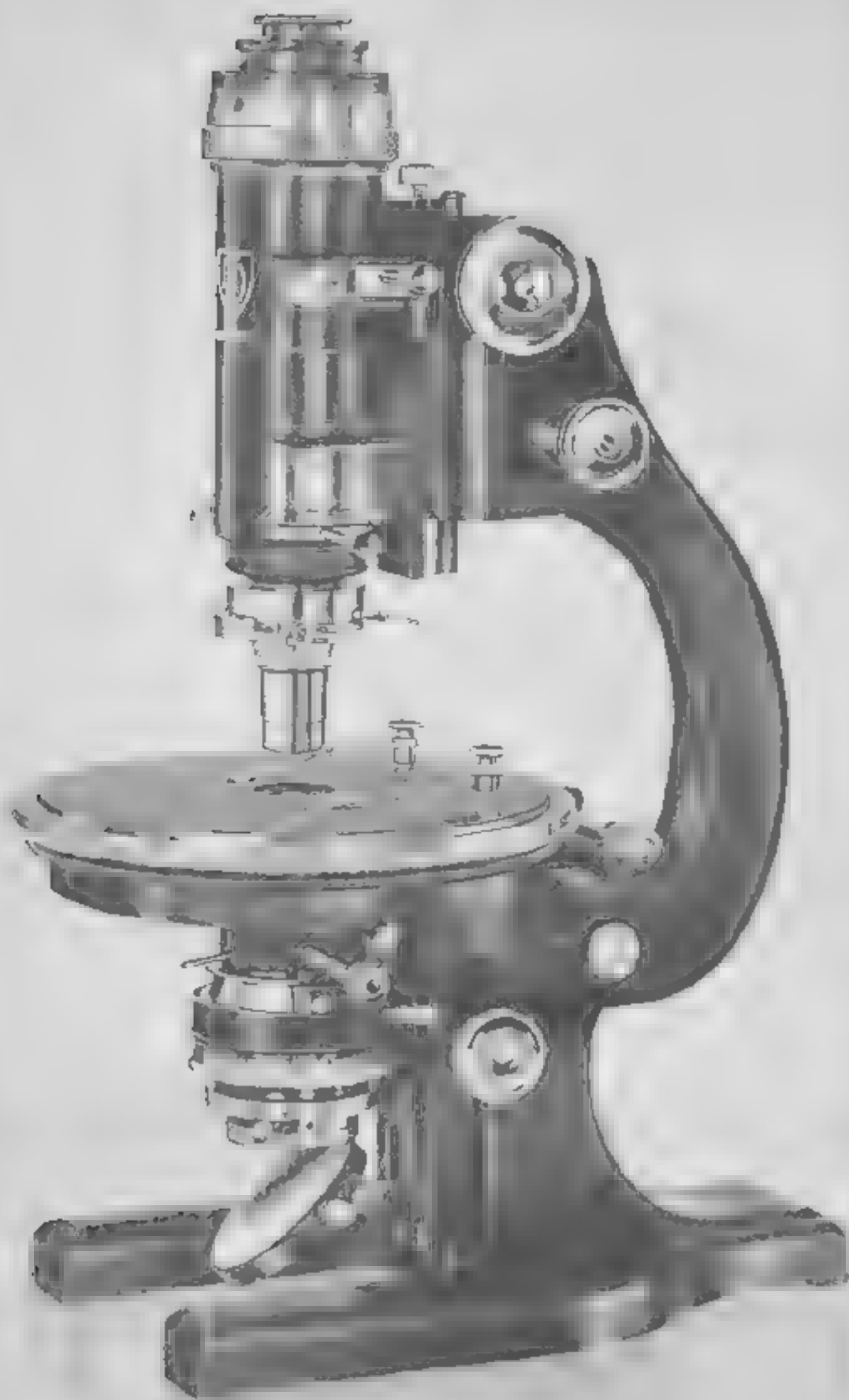
The Becke aperture plate consists of two diagonal apertures at right angles to each other, a clear circular aperture, and a half-wave plate. This accessory is particularly useful in determining refractive index by means of the Becke line method.

The quarter-wave plate and full wave plate are useful in routine determinations of birefringence and optical signs.

In addition to the compensators already mentioned, a quartz wedge is available for use in the body tube slot. It provides compensation from a true zero order to the third order.

A graduated quartz wedge, complete with upper analyzer, is also available. It is more fully described on the accessories pages.







## Research Polarizing Microscope No. 37

Spencer Research Polarizing Microscope No. 37 offers great convenience and adaptability to the petrographer. It has features of precision ample for practically any measurements and is suitable for many different types of work. This is the instrument usually selected for advanced crystallographic work in government laboratories, and for microscopical research with polarized light in all types of laboratories. It will accept both the integrating stages and universal stages.

### STAND

The stand is large, 116mm from optical axis to arm, 145mm from table to stage and 74mm above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 80mm. A dovetail slide permits 32mm additional excursion.

The micrometer screw-type fine adjustment is graduated to show 0.001mm of movement.

### BODY TUBE

A large sized body tube with large eyepiece tube and probe eyepiece is included.

The analyzer, a 12 millimeter Ahrens prism, is available in either a fixed or rotatable graduated mount.

The extra focusing Bertrand lens is in a separate mount with a stop for the prism. A quick-change centerable nosepiece with three objective centering rings is standard equipment.

### STAGE

The 150mm ball bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A slow motion adjustment is available at slight additional charge.

### SUBSTAGE EQUIPMENT

No. 332 combined condenser is supplied. It has interchangeable front elements providing N.A. 1.40 and N.A. 1.3, complete with 15 millimeter Ahrens prism polarizer in graduated rotatable mount with 100mm dia.

### OPTIONAL

The microscope comes in a polished hardwood cabinet with velvet-lined accessory case, lock, and key.

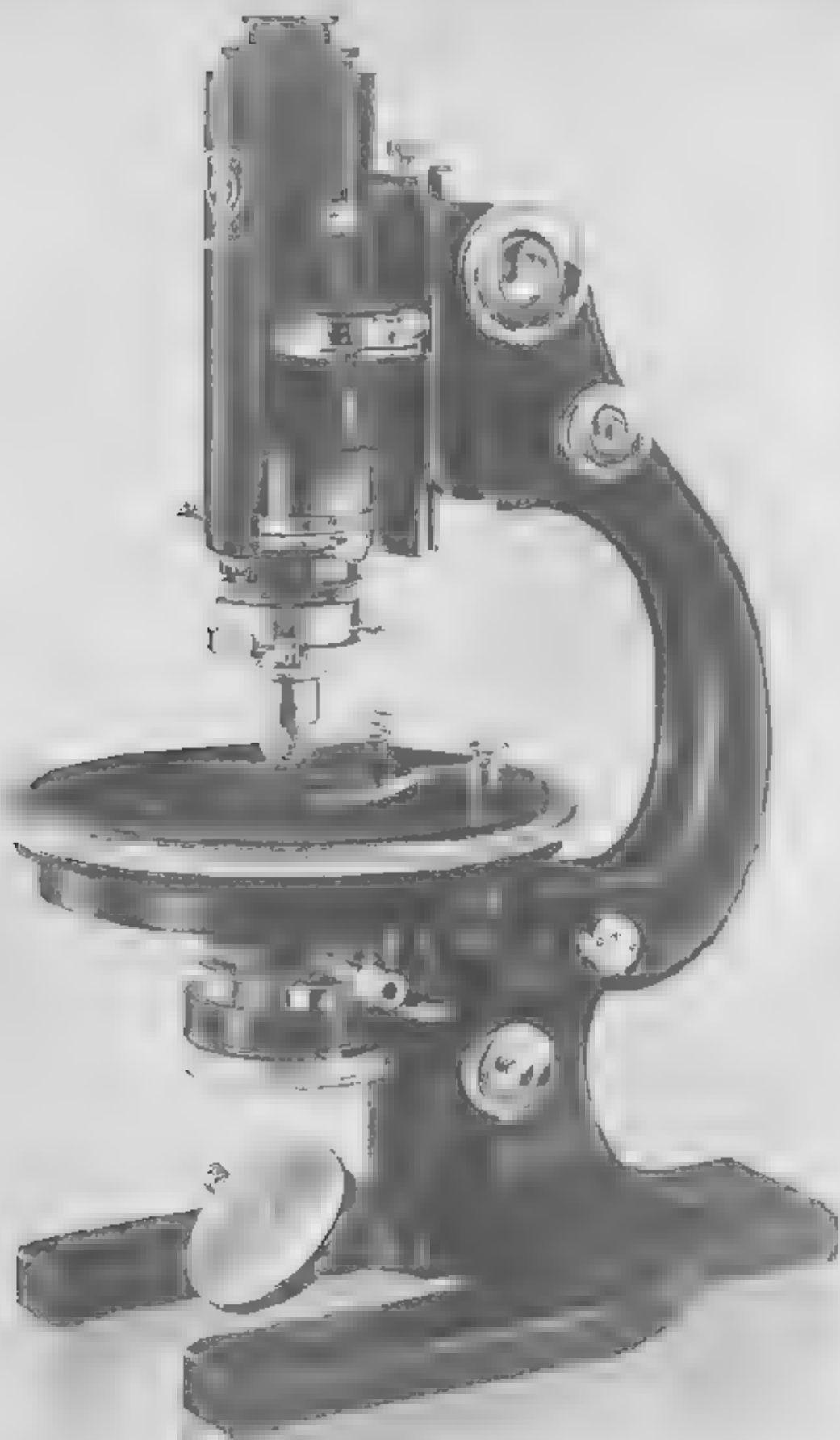
Call  
No.

Price

37 A Spencer Research Polarizing Microscope as above, having spare focusing Bertrand lens, probe eyepiece, combined condenser N.A. 1.40 and N.A. 1.3, with 15 millimeter Ahrens polarizing prism non-graduated, centerable analyzer optional.

37 B Spencer Research Polarizing Microscope, same as above, but with rotatable analyzer optional.







## Large Polarizing Microscope No. 39

Spencer Large Polarizing Microscope No. 39 provides a large, rigid, stable stand with adequate distance below the stage for any illuminating accessories, and sufficient space above the stage to accommodate any of the universal stages. This instrument differs from No. 37 only in being able to use condenser equipment and is included to meet the requirements of those who do not need the high aperture condenser and the convenience of the spiral focusing Bertrand lens.

### STAND

The stand is large 116mm from optical axis to arm 45mm from table to stage, and 74mm above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 12mm. A dovetail slide permits 42mm additional movement.

The micrometer screw-type fine adjustment is graduated to show 601mm of movement.

### HOODY TRIP

A large sized body tube with large eyepiece tube and pinkie eyepiece is included.

The analyzer, a 12 millimeter Ahrens prism, is available in either a fixed or rotatable graduated mount.

The hand focusing Bertrand lens is in a centerable mount with iris diaphragm.

A quick-change centerable nosepiece with three objective centering rings is standard equipment.

### STAGE

The 150mm diameter bearing revolvable stage has the periphery graduated in degrees from 0 to 360. A slow motion adjustment allows rotation of the stage at right angles to the optical axis.

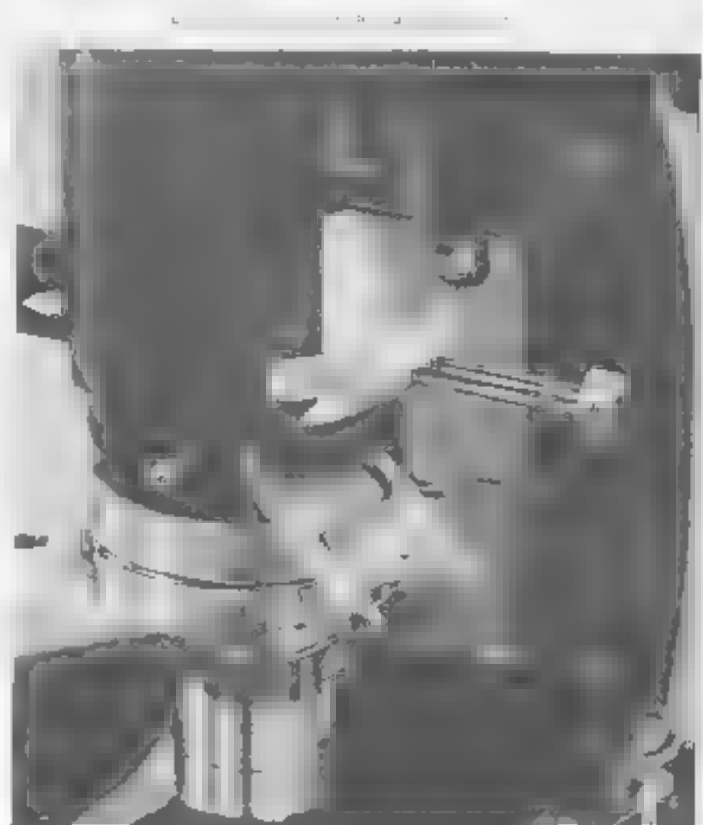
### SUBSTAGE

The No. 530 combined condenser is supplied. It has a numerical aperture of 1.0. The 12 millimeter Ahrens prism polarizer is in a graduated rotatable mount.

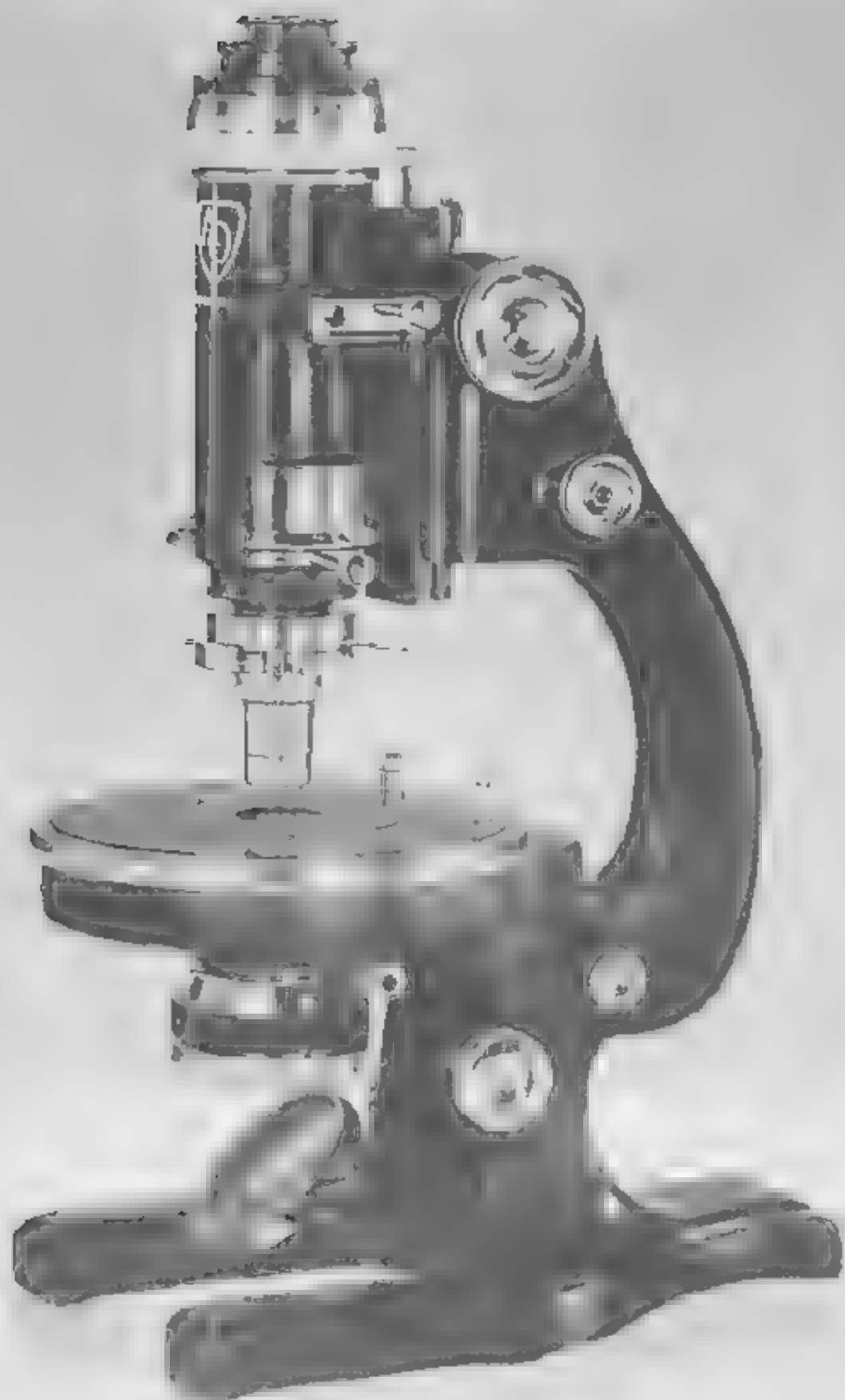
### CABINET

The microscope comes in a polished mahogany cabinet with velvet-lined accessory case, lock, and key.

No.	Description	Price
39A	Spencer Large Polarizing Microscope with hand focusing 1.0 condenser with 12 mm Ahrens polarizing prism and grad rotatable mount	\$1,200.00
39	Spencer Large Polarizing Microscope with hand focusing 1.0 condenser with 12 mm Ahrens polarizing prism and grad rotatable mount	\$1,100.00









## Polarizing Microscope No. 40

Spencer Polarizing Microscope No. 40 is a complete instrument for work in polarized light. This instrument, and No. 41 described on the following pages, are widely used in industrial laboratories. It will accommodate the integrating stages and the smaller universal stages. The convenience of the spiral focusing Bertrand lens is a real advantage during extensive routine examination of interference figures. The plain bearing stage is adequate for all but the most critical work. The wide field afforded by the large diameter eyepieces is another feature appreciated where a large volume of work is handled regularly.

### STAND

The stand is standard in dimensions: 103mm from optical axis to arm, 132mm from table to stage, and 64mm above the stage.

The coarse adjustment, by differential rack and pinion, provides a movement of 70mm. A dovetail shoe permits 32mm additional excursion.

The micrometer screw-type fine adjustment is graduated to show 0.025mm of movement.

### BODY TUBE

A large sized body tube with large eyepiece tube and pinhole eyepiece is included.

The analyzer is 17 millimeter Ahrens, is available in either a fixed or rotatable mount.

The spiral focusing Bertrand lens is in a centerable mount with iris diaphragm. A quick-change nosepiece with three objective centering rings, or a non-centerable, triple revolving nosepiece may be specified.

### STAGE

The 123mm plain bearing, non-centerable, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

### SUBSTAGE EQUIPMENT

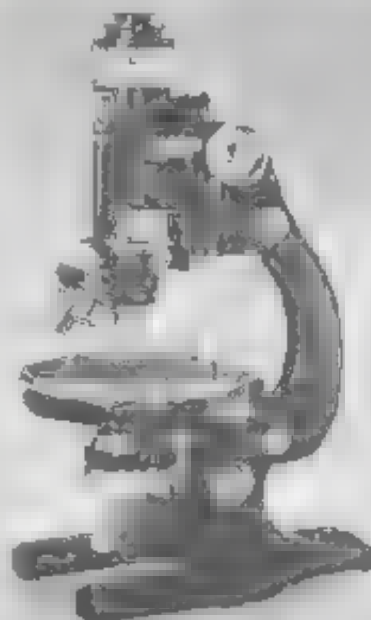
The No. 530 combination NAJG condenser includes a 12 millimeter Ahrens prism polarizer in a graduated rotatable mount.

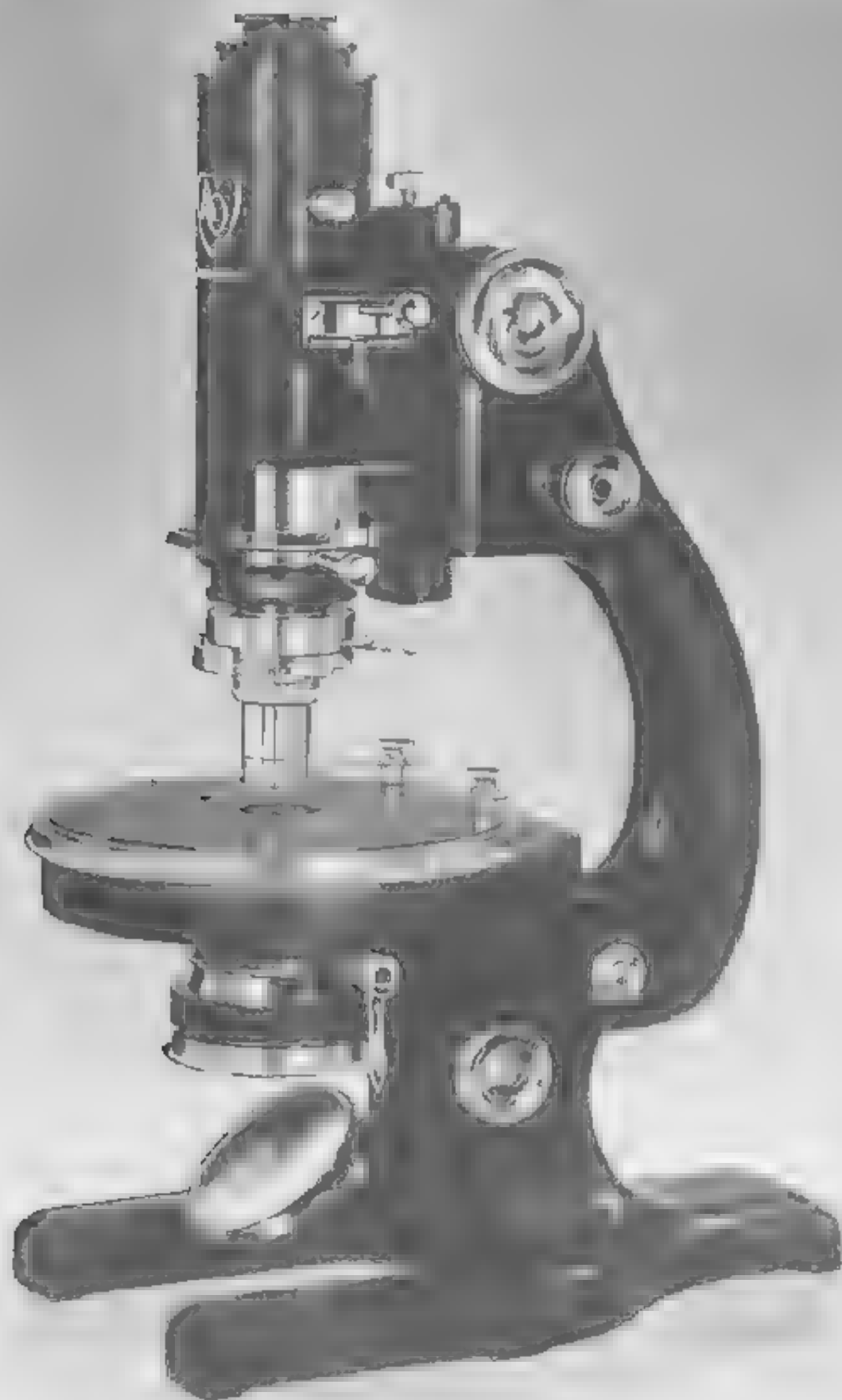
### CABINET

The microscope comes in a leatherette covered hardwood cabinet with a velvet-lined accessory case, lock, and key.

Cat. No.	Description	Price
40A	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer	
40BC	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer	
40AD	Spencer Polarizing Microscope, same as No. 40A, but with a triple revolving nosepiece and centerable stage	
40HD	Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer	

Spencer Polarizing Microscope No. 40AD







## Polarizing Microscope No. 41

Spencer Polarizing Microscope No. 41 is identical with No. 40 described on the preceding page, except that the sliding focusing Bertrand lens is supplied instead of the spiral focusing feature.

This microscope, like other Spencer Polarizing Microscopes, can be equipped with any of the objectives, eyepieces, or compensators for either routine or advanced work.

### STAND

The stand is standard in dimensions: 103mm from optical axis to arm, 132mm from table to stage, and 64mm above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 70mm. A dovetail slide permits 32mm additional excursion.

The micrometer screw-type fine adjustment is graduated to show 0.05mm of movement.

### BODY TUBE

A large sized body tube with large eyepiece tube and pinhole eyepiece is furnished.

The analyzer, a 12 millimeter Ahrens prism, is available in either a fixed or rotatable mount.

The sliding focusing Bertrand lens is in a centerable mount with iris diaphragm. A quick-change centerable nosepiece with three objective centering rings or a non-centerable triple revolving nosepiece may be specified.

### STAGE

The 125mm plain bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

### ANALYZER EQUIPMENT

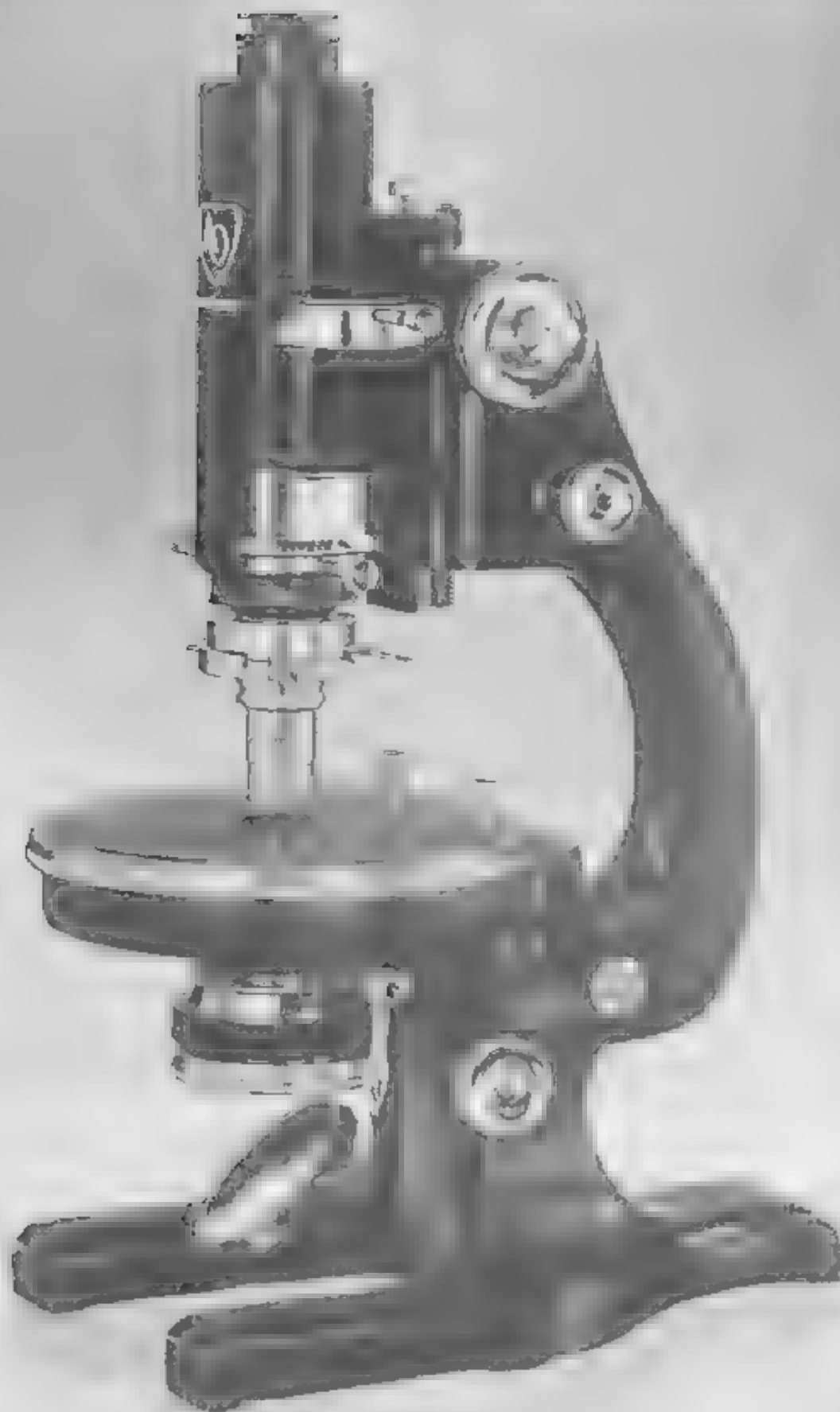
The No. 530 compound No. A 10 non-rotatable analyzer is available with a strain polarizer in a graduated rotatable mount.

### CABINET

The microscope comes in a leatherette covered hardwood cabinet with a velvet-lined accessory case lock, and

- |       |  |
|-------|--|
| 41    | Spencer Polarizing Microscope, same as described, having non-rotatable analyzer                      |
| 41 DC | Spencer Polarizing Microscope, same as above, but with double objectives, eyepieces, or compensators |
| 41 DC | Spencer Polarizing Microscope, same as above, but with non-rotatable analyzer                        |
| 41 DC | Spencer Polarizing Microscope, same as above, but with triple revolving non-centerable stage         |
| 41 DC | Spencer Polarizing Microscope, same as above, but with triple revolving non-centerable stage         |







## Polarizing Microscope No. 42

Spencer Polarizing Microscope No. 42 is a complete microscope for work in polarized light at a minimum price. The use of Polaroid of precision optical quality instead of Abrens prisms, the fixed focus Bertrand lens, and the standard diameter eyepieces make significant economies possible. Optically and mechanically the instrument is capable of the finest work. It is particularly well suited to satisfy the need for a complete instrument for students. It is also well adapted to the needs of the industrial control laboratory.

### STAND

The stand is standard in dimensions: 103mm from optical axis to arm, 132mm from table to stage, and 64mm above the stage.

The coarse adjustment, by diagonal rack and spiral pinion, provides a movement of 76mm. A dovetail slide provides fine adjustment.

The micrometer screw-type fine adjustment is available as an optional feature.

### BODY TUBE

A large sized body tube with standard diameter eyepiece tube and parallel eyepiece is included.

The analyzer (a synthetic crystal, Polaroid), is available in either a fixed or rotatable mount.

The prefocused Bertrand lens is in a sliding mount.

A quick change centerable nosepiece with three objective centering rings or a triple revolving nosepiece may be specified.

### STAGE

The 125mm plain bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving nosepiece is specified.

### SUBSTAGE EQUIPMENT

The No. 533 combined N.A. 1.0 condenser includes a Polaroid polarizing filter in a graduated rotatable mount.

### CABINET

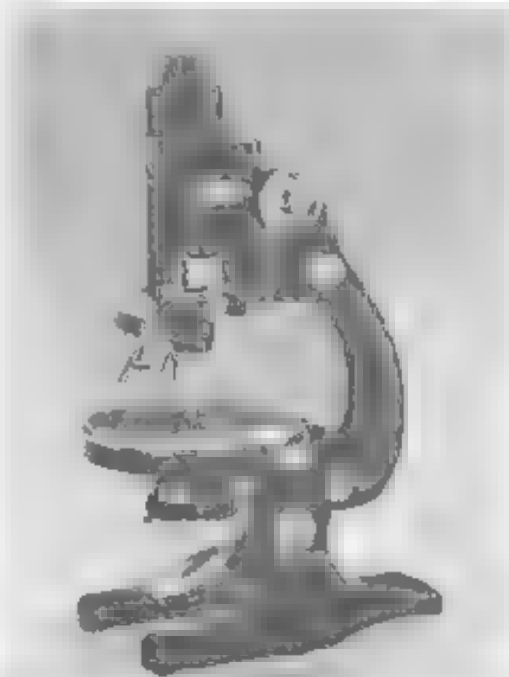
The microscope comes in a leatherette covered hardware cabinet with a velvet-lined accessory case, lock, and key.

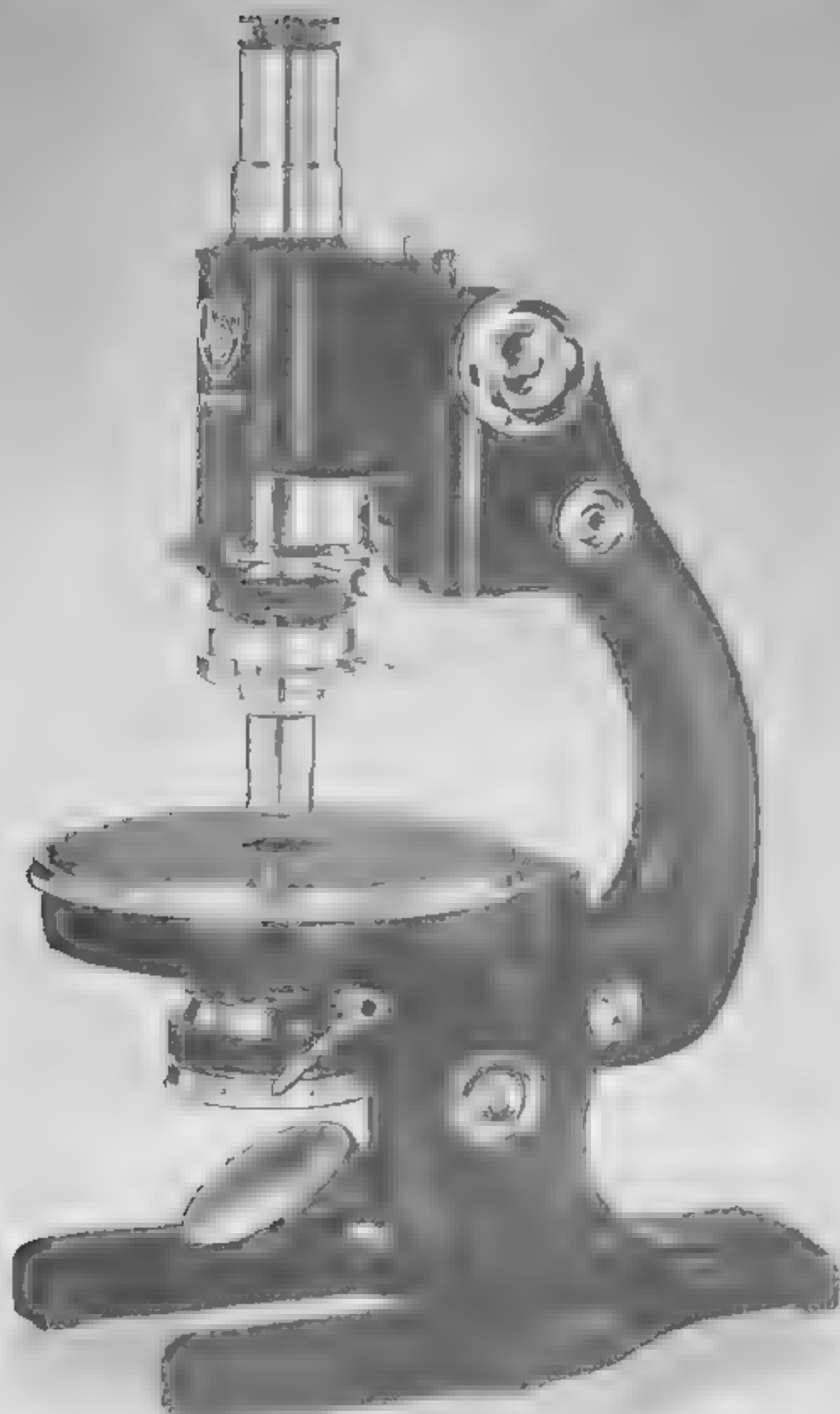
Cat. No.	Description	Price
42	Polarizing Microscope as described, including Polaroid polarizer (the ever prefocused Bertrand lens, standard eyepiece tubes, photo change centerable nosepiece, three objective centering rings, and a triple revolving nosepiece may be specified.)	\$125.00

4210C Spencer Polarizing Microscope with cabinet, lock, and key. \$150.00

4210D Spencer Polarizing Microscope with cabinet, lock, and key. \$150.00

4210E Spencer Polarizing Microscope with cabinet, lock, and key. \$150.00







## Polarizing Microscope No. 43

Spencer Polarizing Microscope No. 43 represents a distinct advance over the conventional 'chemical' microscope. The analyzer in the body tube affords a substantially larger and more usable field of view, the cap analyzer, and eliminates the very low eyepoint. This instrument offers the same optical and mechanical features as the No. 42, except that no Bertrand lens is supplied. Where examination of the interference figure with the pinhole eyepiece only will suffice, the No. 43 Microscope offers a low cost instrument of a quality fully comparable with the other Spencer Polarizing Microscopes.

## STAND

The stand is standard in dimensions: 103mm. from optical axis to arm, 131mm. from table to stage, and 64mm. above the stage.

The coarse adjustment, by diagonal rack and pinion, provides a movement of 70mm. A dovetail slide permits 32mm additional excursion.

The micrometer screw type bar adjustment is graduated to show 0.25mm. of movement.

## BODY TUBE

A large sized body tube with standard diameter eyepiece tube and probe eyepiece is included.

The analyzer is a Polaroid disc of optical quality, is available in either a fixed or rotatable mount.

A quick-change detachable nosepiece with three objective centering rings or a triple revolving nosepiece may be specified.

## STAGE

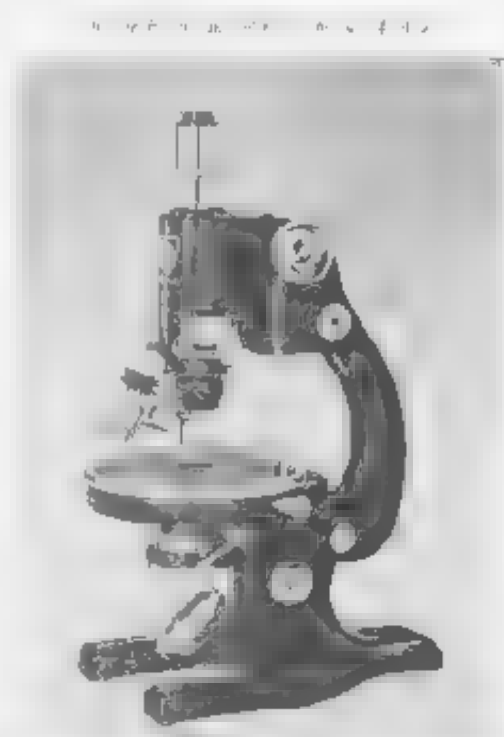
The 125mm plate bearing, revolving stage has the periphery graduated in degrees with a vernier reading to three minutes of arc. A centerable stage is supplied when a non-centerable revolving microscope is specified.

### SUBSTAGE EQUIPMENT

The No. 533 N A. & O condenser includes a Polaroid disc in a graduated rotatable mount.

## CAPINET

The microscope comes in a leatherette covered hardwood cabinet with a Yale-locked accessory case, lock, and key.

[illegible]





## Accessories for Polarizing Microscopes

### Strain-Free Achromatic Objectives

All Spencer Strain-Free Objectives are plainly marked with the equivalent focus, the numerical aperture and the initial tube length of 166.4mm. The magnifica-

tion of the objective and eyepiece is always the product of the initial magnification of the objective and that of the eyepiece. The Spencer objectives, eyepieces, and condensers are designed to work together and, when used in proper combination, will give the finest results.

All Spencer Strain-Free Objectives listed are corrected for a cover glass thickness of 0.18mm.

Cat. No.	Equivalent mm	Initial Magnification	Type	Numerical Aperture	Working Distance mm	Price
447	48	2.2	dry	0.08	52.5	
448	40	2.8	dry	0.08	35.2	
449	32	4.0	dry	0.10	21.0	
450	25	5.6	dry	0.17	11.0	
451	16	10.0	dry	0.25	4.5	
452	8	20.0	dry	0.50	1.44	
453	4	40.0	dry	0.66	0.63	
454	4	45.0	dry	0.85	0.70	
455	3	60.0	dry	0.85	0.20	
456	1.8	25.0 vs. 1mm		1.25	0.13	

\*This objective is separable. When the front element is removed the back system becomes a 32mm.

### Cross Hair Eyepieces

Cross Hair Eyepieces for Spencer Polarizing Microscopes have focusing eye piece. They are made in large diameter 30.00mm, for microscopes having the large

diameter eyepiece tube, as well as in standard diameter, 23.22mm. An adapter is listed to fit the large diameter eyepiece tubes so that standard diameter eyepieces may be used.

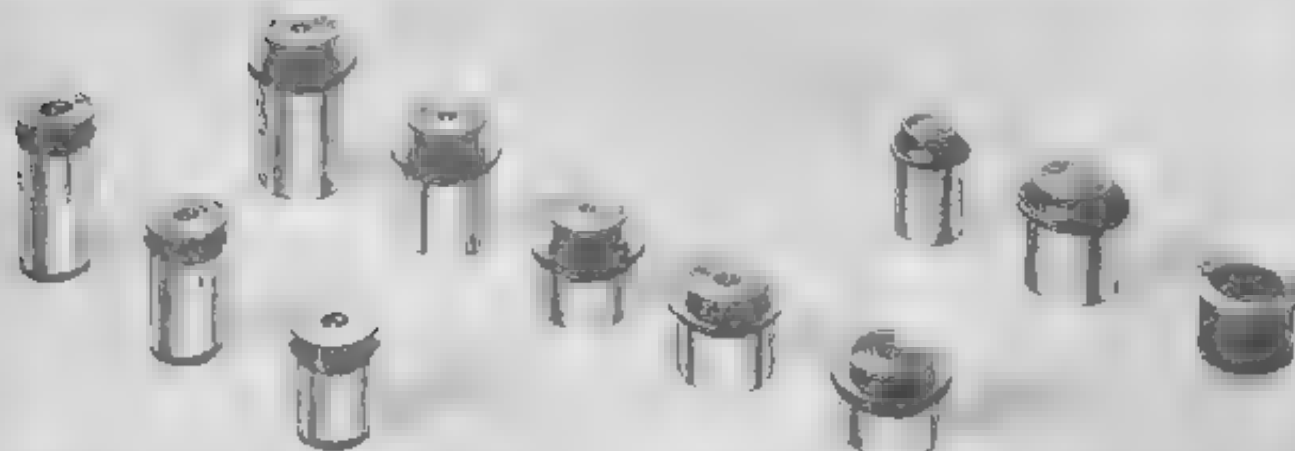
Cat. No.	Description	Price
447	Cross Hair Eyepiece, 6X standard	
448	Cross Hair Eyepiece 8X standard	
449	Cross Hair Eyepiece 10X standard	
450	Cross Hair Eyepiece 16X large size	
451	Cross Hair Eyepiece 20X large size	
452	Cross Hair Eyepiece 25X large size	
453	Cross Hair Eyepiece 40X large size	
454	Cross Hair Eyepiece 45X large size	
455	Cross Hair Eyepiece 60X large size	
456	Adapter for standard 23.22mm large diameter tubes	

### Pinhole Eyepieces

Cat. No.	Description	Price
457	Pinhole Eyepiece 10X large size	

### Nosepieces

Cat. No.	Description	Price
458	Double Revolving Nosepiece (center auto)	
459	Triple Revolving Nosepiece (center auto)	
460	Quick-Change Nosepiece	
461	Objective Centering Ring	





## Substage Equipment

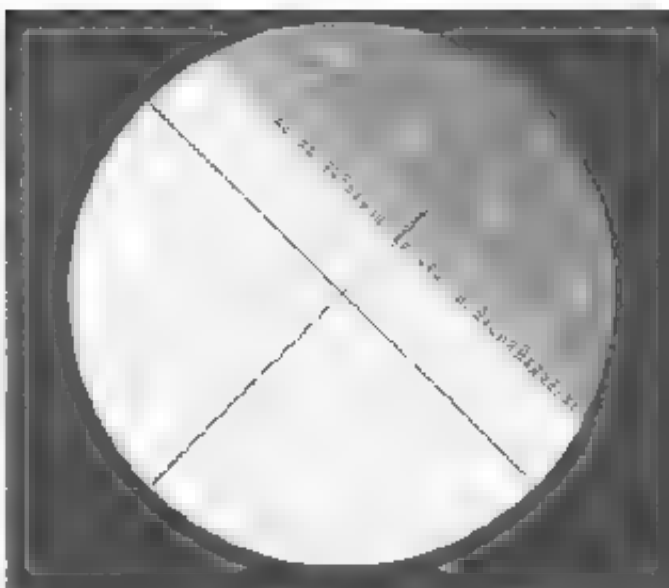
Substage equipment is described completely in the introductory material. The following chart shows the microscopes on which each may be used.

Microscope	Substage Equipment
1	1
2	2
3	3
4	4
5	5

Microscope	Substage Equipment
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
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86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

## Graduated Quartz Wedge

The Graduated Quartz Wedge consists of three principal parts: a quartz wedge with a scale on the top surface mounted in a slide, a holder which clamps over the top of the body tube and contains the cross



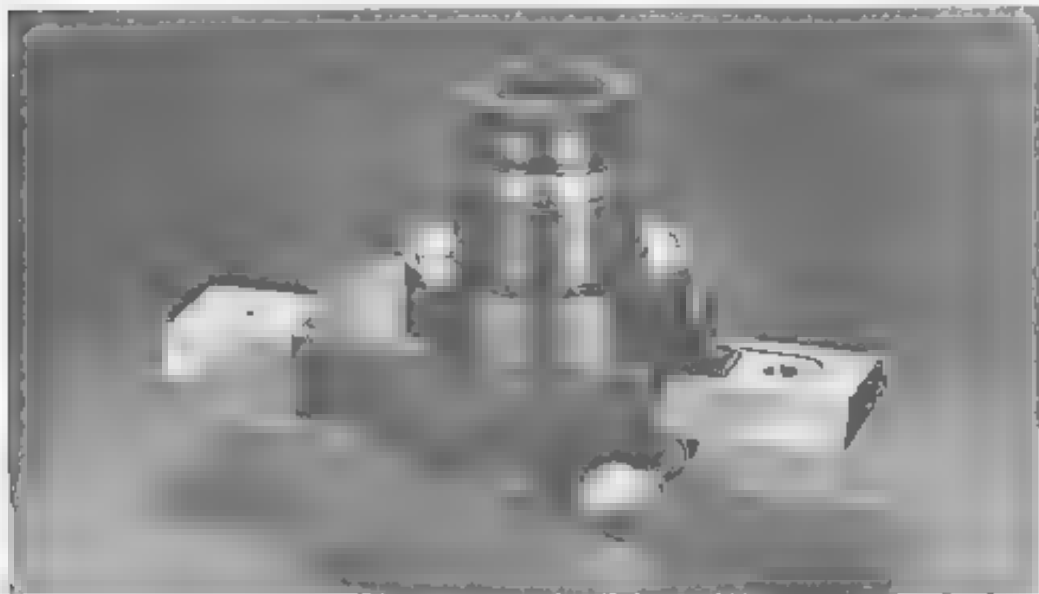
line disc and a Pyrex disc and a special Rembrandt evenness which may be focused on the scale and cross lines.

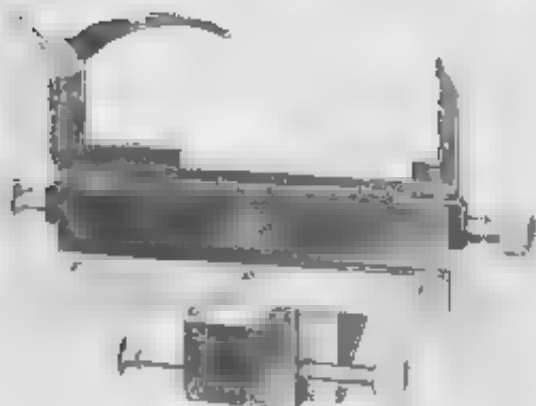
The graduations on the quartz wedge are from -500 to +7500mμ with lines at 10mμ intervals. Estimates can be made to 2mμ. The lines and numerals are engraved through a semitransparent metalized surface. After the engraving, the metal is fused to the quartz so that the engraving is permanent.

The graduations appear bright on a semitransparent area at the edge of the wedge. This construction contributes materially to the comfort and ease of making accurate quantitative measurements of birefringence.

Fig. 1. Graduated Quartz Wedge complete as described above.

No. 533 Graduated Quartz Wedge





No. 495 Mechanical Stage

### Mechanical Stage

All Spencer Polarizing Microscope Stages are drilled and tapped to take the No. 495 Mechanical Stage No. 495. It is easily attached, revolves with the stage, and when removed, leaves a clean, even surface. This stage has a lateral excursion of 75mm and a to-and-fro movement of 25mm. It is graduated in millimeters with verniers reading to 0.1mm. There are operating buttons on either side of the microscope, available for either hand.

Cat No.	Description	Price
495	Mechanical Stage for Spencer Polarizing Microscopes. In earthenware	



Compensators. Left to right Nos. 543, 542, 541, 544

### Compensators

Below are listed accessories for determining the nature of birefringence. These are in metal mounts fitting the slot in the lower end of the body tubes of all Spencer Polarizing Microscopes. The mount is marked with an arrow to indicate the direction of the retarded or so-called slow ray.

Cat No.	Description	Price
541	1st Wave Plate, 1st order red	
542	Quartz Wedge, 1 to 10 order	
544	Quartz Wave Plate	
545	Becke Aperture Plate	

## Optical Measuring Instruments

Of great importance in industry and education are instruments designed for the investigation of the physical properties of materials by means of light and for the study of the properties of light itself.

Under this classification are described the following:

- A Refractometers in three types: Simple, Automatic, and High Index.
- A Graduated Circle Spectrometer for measuring refractive index and for studying spectra.
- A Dubosq type Colorimeter of advanced design.

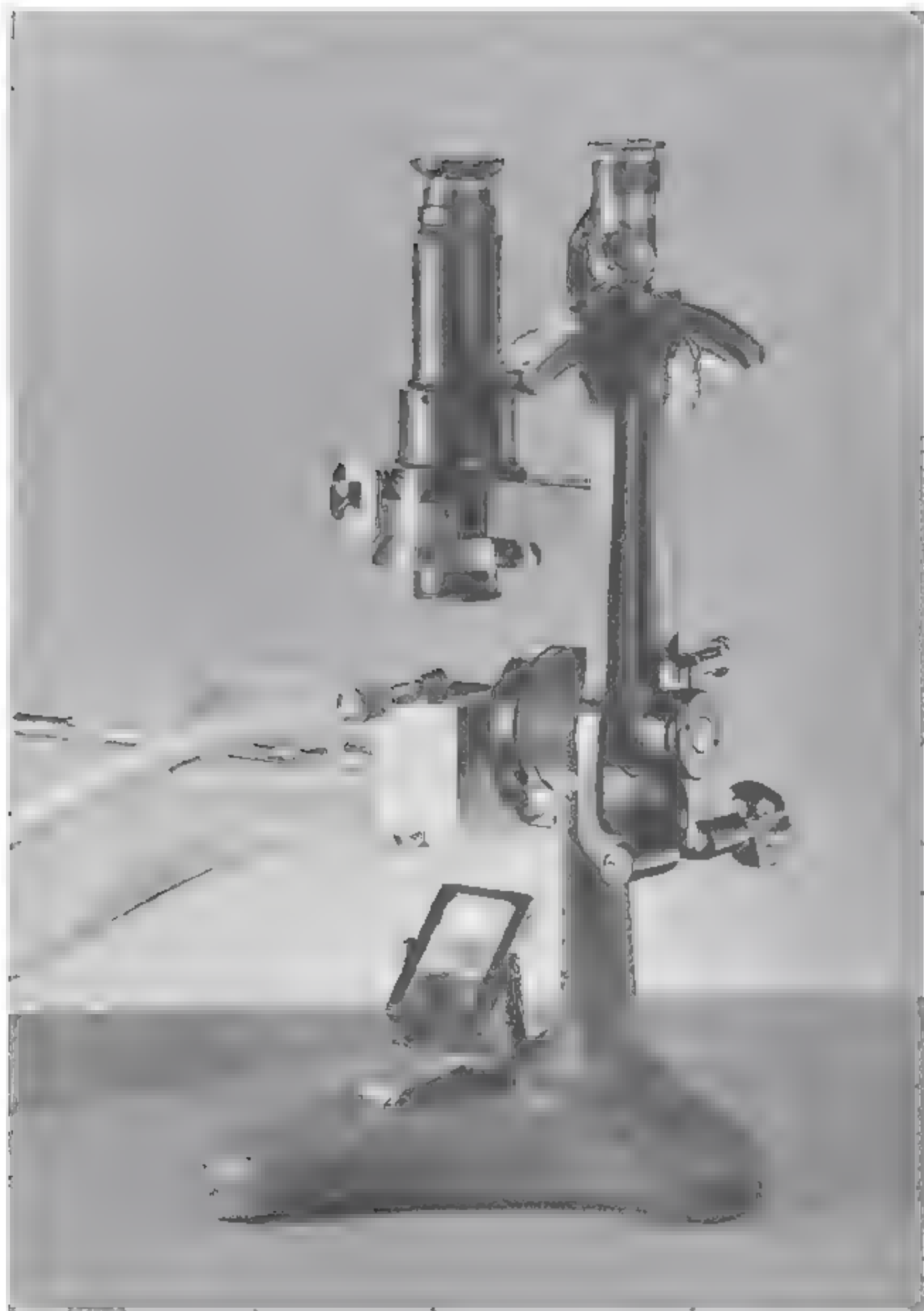
Optical measurements, such as the determination of refractive index, often provide a quick and convenient method of control when correlated with industrial processes. Wherever a definite relationship exists between refractive index and the variables of the process, the refractometer is invaluable for guarding quality, increasing output, and reducing costs. Every day an instrument is being found for use in the food process, petroleum, paint and varnish, chemical, rubber, oil, and fat, distilling, pharmaceutical, plastics, and many other industries.

The graduated circle spectrometer provides a means of study of spectra and of measuring angles and refractive index. It is valuable to many industrial laboratories, and has long been the ideal classroom instrument for demonstration of the optical

properties of prisms and for teaching geometry. In fact, the complete set of accessories forms the major part of the equipment of many schools.

The measurement of light absorption in color is a rapidly expanding business. It involves many chemical and physical laboratories. The Spencer Dubosq-type Colorimeter provides rapid, accurate measurements of color in many industries, such as petroleum, painting, oil and fat, brewing, chemical, metals, drug, and medical laboratories. It is being generally used in all of these industries.







## Spencer Refractometers

The Spencer Abbe Refractometer pro-

viding the refractive index and dispersion of liquids and solids. These optical constants, as correlated with many industrial processes, form a convenient basis of control. The high precision of the Spencer Refractometer also makes it a valuable instrument for research.

### Scale Graduations and Range

Six types of Spencer Refractometers are available. There are three instruments with different series, either with or without Amici prisms. The scales are graduated so that the refractive index ( $n_D$ ) can be read directly to the third decimal place and can be estimated to the fourth. All scales are graduated directly in units of refraction or the D line of the sodium spectrum.

### The Standard Abbe Scale

The scale which is supplied on Spencer Standard Refractometers, Catalog Nos. 10074 and 10075, covers a range of  $n_D$  1.300 to  $n_D$  1.711. The graduations are numbered in both directions so that they may be read easily from either side of the instrument.

### The Sugar Scale

The scale on Spencer Sugar Refractometers, Catalog Nos. 10084 and 10085, is graduated on one side to read directly in percentages of sugar in solution from 0 to 45%. The other side is graduated in refractive index and covers a range of  $n_D$  1.300 to  $n_D$  1.710.

### The High Index Scale

The scale on Spencer High Index Refractometers, Catalog Nos. 10090 and 10091, having special high index base prisms, covers an index range of  $n_D$  1.450 to  $n_D$  1.840.

### Color Compensation and Dispersion Measurement

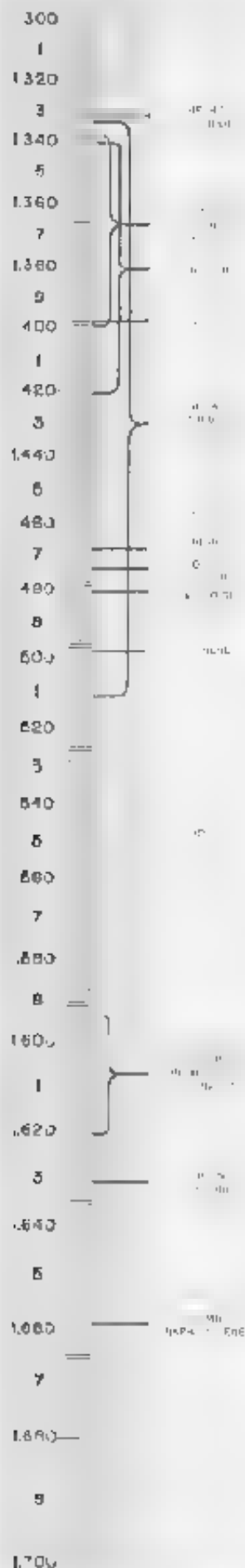
Instruments with Amici prisms are produced for those who prefer to work with white light. The purpose of these direct vision, compensating prisms is to achromatize the spectrum produced by refraction of white light going through the sample and primary prism. By rotation of the Amici prisms, the spectrum is concentrated into a sharp dividing line which is seen through the telescope. The scale reading is in terms of monochromatic sodium light even though white light is used for illumination. Dispersion ( $n_r - n_D$ ) of the sample can be estimated, using a table furnished with the instrument and the reading from the compensator adjustment drum.

Spencer Refractometers without Amici compensating prisms are available for use with monochromatic light for those who prefer the utmost precision in an Abbe type instrument. These instruments are graduated to give index of refraction directly when used with monochromatic sodium light (589m $\mu$ ). By using special conversion tables, other monochromatic light sources can be utilized in measuring refractive index. Thus, by employing conversion tables for the F (486m $\mu$ ) and C (656m $\mu$ ) lines of the hydrogen spectrum, dispersion ( $n_F - n_C$ ) of the sample can be determined directly, using a hydrogen discharge tube for the light source with suitable filters.

### Construction

A heavy cast iron base maintains the alignment of the Spencer Refractometer even at the maximum working inclination. All mechanical parts are carefully fitted to facilitate smooth, precise settings. The dividing line of the field is set to coincide with the cross hairs by manual positioning of the prism anastode, and fine adjustment is made by means of a tangent screw.

An achromatic objective brings all rays of any one emergence angle to a sharp focus in the plane of the cross hairs. An eye lens, focusable in a spiral mount, facilitates the



setting of the instrument by providing a sharp, enlarged image of the dividing line and cross hairs.

Water jackets around the base prism and the illuminating prism provide a means for controlling temperature. A window in the back of the base prism water jacket may be opened to admit light for obtaining the refractive index of materials that do not transmit sufficient light for the usual procedure, or have no side lighting, while grazing incidence light can be admitted. The illuminating prism may be removed for the examination of solids.

The Spencer Refractometer is finished in black baked enamel and chromium plating. A glass test block, a thermometer, thermometer guard, and a small bottle of glycerine are included in the standard equipment.

### Industrial Applications of the Refractometer

**FOOD** Helpful in the dairy laboratory to estimate sugar in sweetened milk, condensed milk, etc. Condensers determine the total solids in milk. Useful for determining the fat content of eggs, etc. Useful for determining the fat content of milk and cream products.

**FUEL** Used for the control of fuel composition and estimation of aromatic content of fuels.

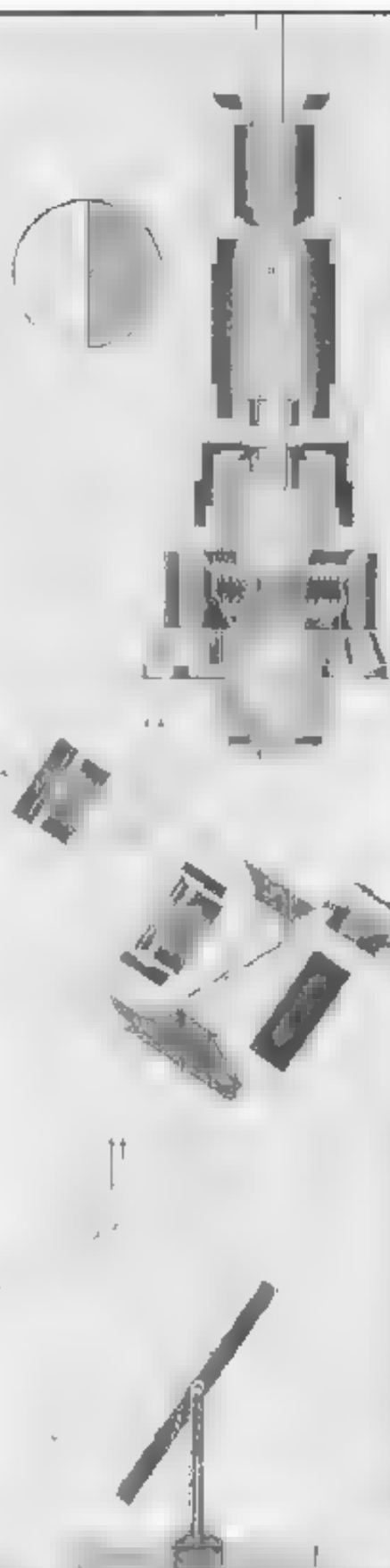
**PAINT AND VARNISH** Used in the identification of oils, the control of heat treatment of varnishes, etc. Useful for the detection of adulteration in paint and varnish.

**CHEMICAL** Used as an aid in the identification of many transparent liquids and solids. Extremely useful for process control where the progress of chemical reaction shows corresponding changes in refractive index.

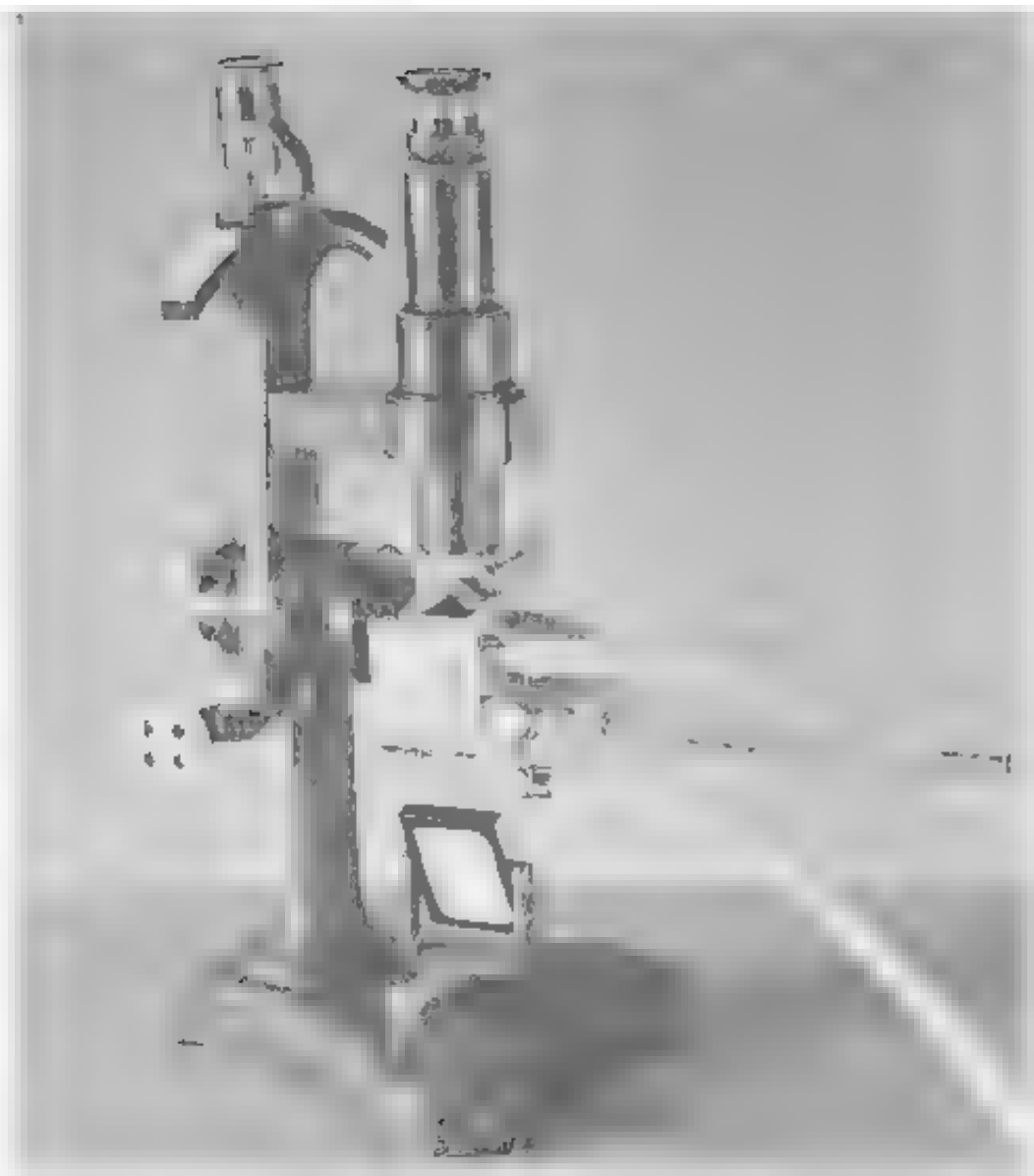
**RUBBER** Used in checking solvents.

**OIL AND FAT** Useful in the identification of oils and fats. Useful for the determination of soap stocks. It also serves in process control (e.g. hydrogenation and saponification).

**DISTILLING** Helpful for checking alcohol content and for determining total solids in solutions.



Path of light through Spencer Refractometer



2. **Решение задачи** (10 баллов)

**PHARMACEUTICAL** Used for the identification of essential oils and waxes and in determining the strength of extracts.

OPTICAL Used to determine refractive index and dispersion of glass.

**PLASTIC** Used to determine optical characteristics of transparent plastics, and control the process of manufacture

10075 Spender Standard Refractometer complete as described, WITH Airtight 300.500

LUCRETIA F. HARRIS

0094 Spencer Sugar Refractometer complete as described. Wt. 17 H Amal prismas

Spencer High Index Refractometer complete as described. Wt. 14 HOU 4 inch prismas

Spectroscopic High Index Refractive " "

Fris 16  
Semi Thermometer 00°C )  
use as R.

Spencer Sub Refractometer com-  
plex as described. With Amal-  
prisms

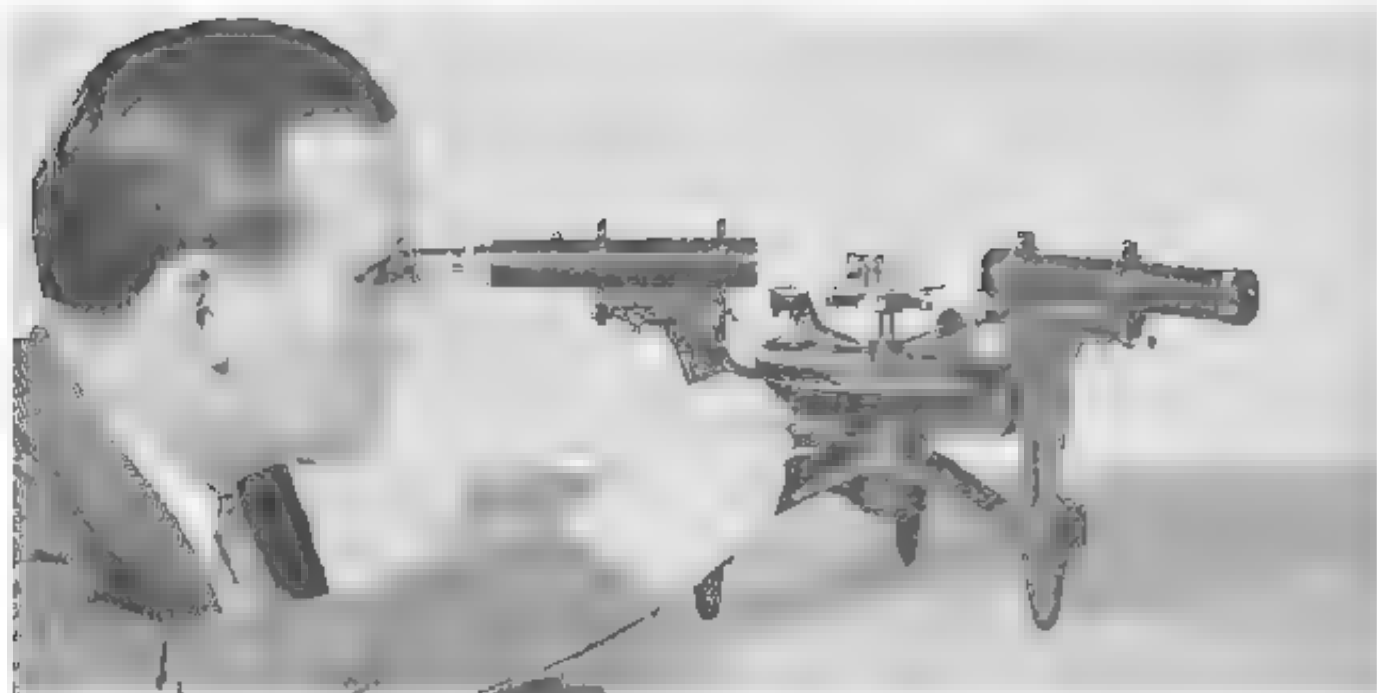
Springer High Index Refractometer  
complete as described, W.T. HOUL  
4140, price:

For more High Index Refractive  
 Lenses  
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Stem Thermometer      00°C ) for  
up to 10

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*The Spencer 10075 Spectrometer with prism and prism stop*

## Spencer Spectrometer

The Spencer 10075 Spectrometer is particularly adapted for use in teaching optics, and together with the 10075 attachment it finds many useful applications in the laboratory.

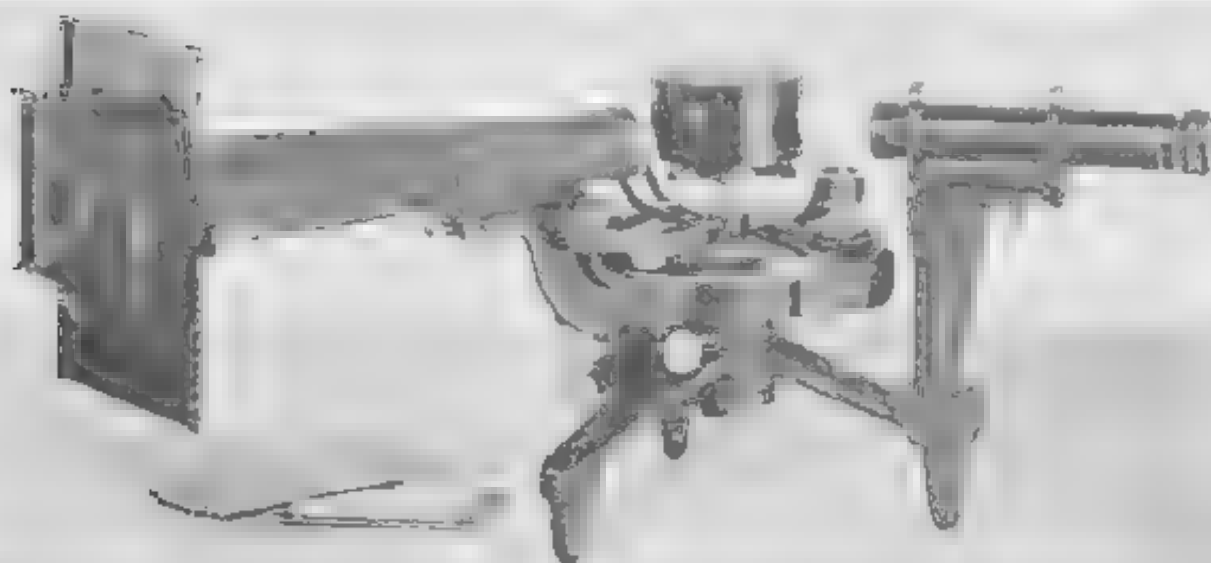
The 10075 Spectrometer is particularly adapted for use in teaching optics, and together with the 10075 attachment it finds many useful applications in the laboratory. The 10075 Spectrometer is particularly adapted for use in teaching optics, and together with the 10075 attachment it finds many useful applications in the laboratory.

as wave-lengths are changed.

The Spectrometer is increased in versatility by an attachment which converts it into a Bunsen-type Spectroscope for laboratory demonstration of the spectral lines. A specially designed camera is available for use in place of the telescope tube, converting it into a Spectrograph.

The Spencer Spectrometer is so adaptable that with a few accessories it constitutes much of the laboratory equipment needed in a course in optics.

*The Spencer 10025 Spectrometer showing 10053 Prism Tube Cover and 10018 Camera in place of the telescope*





## Structural Features

The Spencer Spectrometer is unusually rugged and is built with a widely spaced, three-point support that contributes to stability. High precision is secured by the special design of the collimator and telescope. The telescope is made of bronze or special composition insures unusual strength and resistance to wear.

The telescope and collimator supports are designed to hold these optical systems rigidly in perfect alignment, even when subjected to constant student use. The easily manipulated clamping device for the vertical adjustment locks the telescope and collimator securely in their supports, thus precluding the annoyance of "creeping." The telescope support is counterbalanced to provide smooth action even when the camera is substituted for the telescope. The slow motion adjustments for the telescope and prism table are built with the same precision as the other parts of the instrument.

The 5 in. diameter divided circle of the Spencer Spectrometer is graduated to half degrees, with verniers on two opposite sides which read to single minutes of arc.

The chromium plated brass circle and verniers are located in the same plane to eliminate parallax, and the close fit between them aids in the ease and rapidity with which readings can be made. The circle and verniers are viewed through glass windows in a dust tight cover. Magnifiers are mounted above the verniers to increase the accuracy of the readings.

The telescope and collimator objectives are well corrected, have a focus of 150mm., and are 25mm. in aperture. This insures more illumination than is usually needed. These objectives have a ratio of focal length to aperture which gives a speed of  $f/6$ .

The usual Gauss type eyepiece, with a focus of 25mm., gives a telescope magnification of 6 diameters. The eyepiece is focusable and has an opening in the side which uncovers a reflector for illuminating the cross hairs.

The slit in the collimator is opened by a cam which is controlled by a knurled ring surrounding the slit housing. The slit is

closed by spring action to prevent damage to the edges of the slit which might occur by the action of a non-viewing mechanism.

The prism table has three leveling screws.

All parts are sturdy built to withstand abuse and still function with precision. The instrument is finished in black with chromium plated brassy parts.

## Accessories

### Spectrographic Camera

A camera has been designed for use with the Spencer Spectrometer. It is used in place of the telescope and is easily mounted in the telescope support by thumb screws.

The camera objective, a triplet, is well adapted for use in this particular instrument. It has an unusually flat field and is well-corrected for chromatic aberration. It is mounted in a draw tube for focusing. A scale is engraved on the draw tube so that it will be easy to repeat focal settings. The lens has a free aperture of 23mm. and a focal length of 100mm.

The camera accommodates 6.5 x 9cm. plates and can be adjusted with the same degree of precision as the telescope.

A slide is provided for shifting the plate up and down, making it possible to obtain a series of exposures on one plate. The position of the plate at each exposure is indicated on a vertical scale. The frame carrying the plate holder is pivoted in the center and provided with a bellows so that the plate can be inclined to focus sharply on the different lines of the spectrum. A scale shows the amount of inclination for future reference. The tilt adjustment is independent of the focusing adjustment because the pivots have been brought into the plane of the photographic emulsion by a special design which allows the vertical slide to carry both the plate holder and the tilt mechanism.

With this camera and the No. 10042 prism it is easy to obtain a spectrum 40mm. long between the mercury lines 404 and 579 millimicrons. With a slightly different adjustment, the near ultra-violet can be photographed somewhat beyond 365 millimicrons. Using suitable plates it is also possible to record the mercury line in the near infrared at 1014 millimicrons.

A sliding plate holder and a ground glass for focusing are supplied with each camera.



The Spencer Spectrometer. 1900. E. S. S. Co.

### Bunsen Spectroscope Attachment

To convert the Spencer Spectrometer into a spectroscope for visual demonstrations and comparisons of spectra of the chemical elements, an additional tube with a graduated scale is provided. This scale is 750 mm. length and divided into tenths of millimeters, with each millimeter numbered. When the scale is illuminated by pointing the tube in the direction of a window, or by artificial illumination of proper intensity, the collimator lens at the other end of the tube forms an image of the scale which is reflected from the surface of the prism and seen in the eyepiece of the telescope. This serves as an arbitrary reference in comparing the relative positions of the Fraunhofer, or other spectral lines. The scale is in a sliding mount for focus. The auxiliary collimator is mounted on the prism table cover which shields the prism from stray light and forms a support for the tube. The prism and its clamp need not be disturbed when using this accessory. It slips into place easily on the prism table.

### Condenser

A condenser on a separate stand is used to form an image of the light source on the

slit, and is particularly valuable with the camera, or when using flame sources, which should not be brought too close to the instrument or to the observer.

### Comparison Prism and Two-Aperture Diaphragm

A comparison prism is available for mounting in front of the top half of the slit. This makes it possible to observe two sources of light with the telescope at the same time. In using this prism, one light source is placed directly in front of the slit, while light from the other source is directed through the comparison prism from the side of the slit. The two spectra may then be seen one above the other in the field of the telescope.

For photography, a two-aperture diaphragm is provided for use in front of the slit. By making an exposure through the diaphragm opening and then through the other, two spectra can be photographed in juxtaposition, one above the other. This is done by placing the diaphragm in the position of the photographic plate,



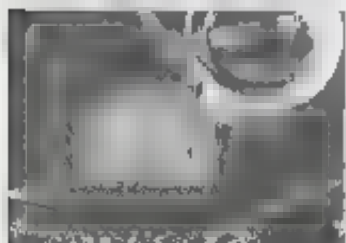
## Prisms

Four prisms are available for use with this instrument. The prism having an index of 1.65 is satisfactory for use with the telescope. The prism with index 1.72 is preferable with the camera because of its 30 per cent greater dispersion. A  $30^{\circ}$ — $60^{\circ}$  constant deviation prism with index 1.72

and a hollow prism for measuring the refractive index of liquids, are also available.

A crimped but effective clamp of new design can be had for holding any of the prisms on the table. A grating clamp can also be supplied. The prism table cover reduces stray light and is particularly valuable for use with the camera.

No.	Description	Price
10025	Spencer Spectrometer as described	
X	Spencer Camera Spectrometer with ground glass focusing screen and single metal plate holder	
X	Bausch Spectroscope attachment for Spectrometer with wave-length scale	
X	Prism Clamp	
X	6 1/2 x 9 1/2 in. Single Metal Plate Holder	
X	Grating Clamp	
X	Prism Table Cover	
X	Two-Aperture Diaphragm for use over Single Comparison Prism	
X	Condensing Lens with adjustable stand	
10040	Prism, $60^{\circ}$ , 18mm. x 36mm. n.d. 1.65	
X41	Prism, $30^{\circ}$ — $60^{\circ}$ Constant Deviation 18mm. x 65mm. n.d. 1.72	
10042	Prism, $60^{\circ}$ High index 18mm. x 36mm. n.d. 1.72	
10045	Hollow Prism 18mm. x 36mm. centered without metal	



Prism

Two-Aperture Diaphragm

Condensing Lens

Prism







## Spencer Direct Result Colorimeter

The radically different appearance of the Spencer Direct Result Colorimeter is the result of many worthwhile improvements made while redesigning the basic instrument—the Duboseq-type Colorimeter. Actual experience has established the value of its sturdy construction and simple design. It is easy and comfortable to operate, highly accurate, and easy to clean.

It is applicable to all chemical and biological tests in which color density is a quantitative indication of composition. Hospital technicians, food processors, petroleum refiners, brewers, and oil companies, textile, and metal manufacturers—all find this instrument valuable in analysis and control.

### Stand

The smooth, unadorned simplicity of the forward sweeping arm and dust-tight base and prism housing, with their minimum of moving parts, makes the Spencer Direct Result Colorimeter unusually easy to clean, light in weight, and sturdy. The base is easily resistant, black, baked enamel finish and chromium plated control parts.

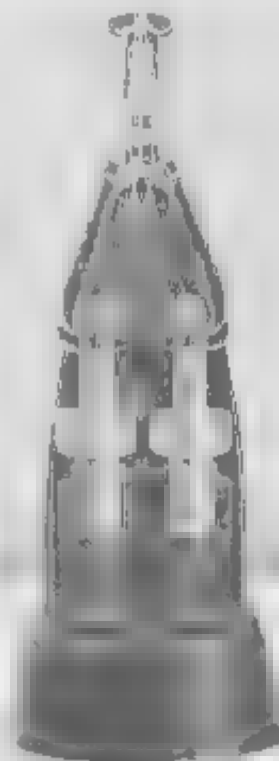
Ampie, precisely controlled illumination provided by a light built into the base, and diffused through windows set flush with the base, can be equalized by a simple, easily reached control, and locked in the desired adjustment. A blue eyepiece filter modulates the illumination to resemble daylight more closely. This provides a constant light, preferable to the variable daylight, and eliminates the necessity for mirrors or accessory lamps.

### Direct Reading Drums

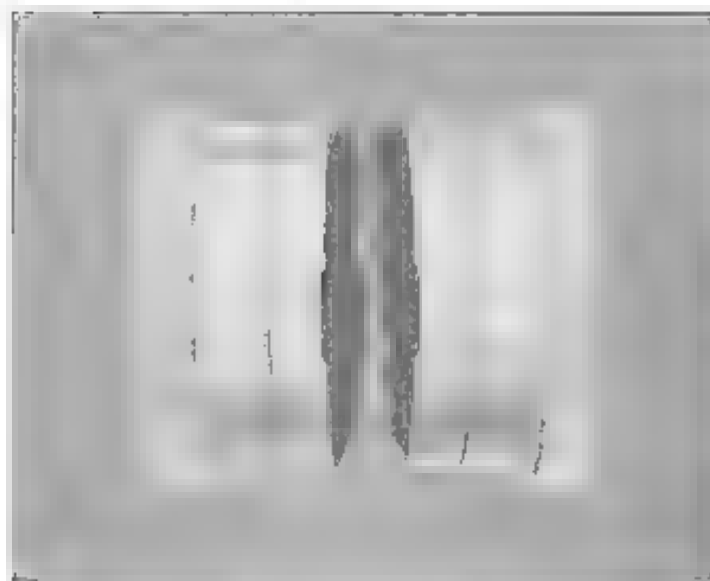
Low on the sides of the instrument within easy reach of hands resting on the

table, are drums, each actuating one of the colorimeter cups, and calibrated with scales on which the percentage concentration may be read directly, without need for tables or calculations. These drums, on which fractional parts are read, and their number rings, divided into units, are calibrated with identical scales so that either cup may be used for the standard.

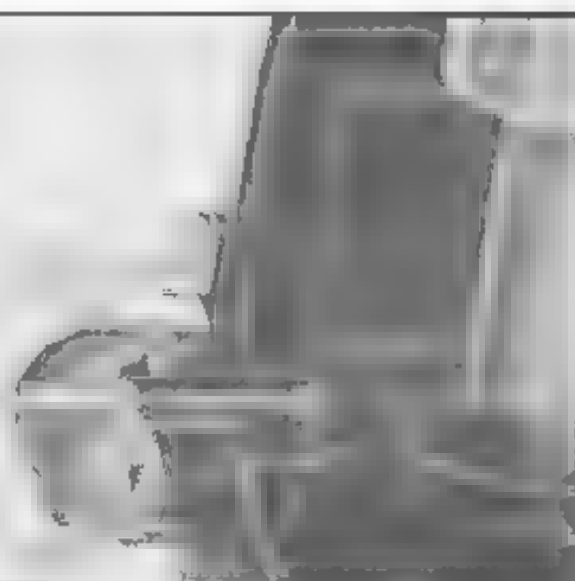
By setting the *sample* at 10.00 (which corresponds to a depth of 40mm) and then adjusting the depth of the *standard* to match the color fields, the scale on the standard side, when multiplied by ten, shows directly the percentage concentration of the sample. Since the scales are graduated in units from 0.00 to 14.00, the colorimeter has a range from 0 to 140 percent when used in this way. The working range may be extended by setting the depth of the sample to other values. Because these drums are stationary at a convenient reading position, they are a one-piece, and the scales are easily read in any desired position.



Each day, light through Spencer Direct Result Colorimeter



Percentage of concentration at visual direct yellow-green



Concentration by the number rating green-blue

### Inclined Eyepiece Tube

Long periods of observation with at fatigue are made possible by the inclined eyepiece tube and light path housing which permit use of the instrument from a comfortable sitting position. The deviation of light necessitated by this inclination of the immovable eyepiece section is observed by accurately adjusted oblique surfaces at the upper ends of the plungers. Plungers are easily accessible by means of correctly placed locating pins.

### Plungers

The plungers are inclined at a slight angle so that the lower ends enter the liquid obliquely to provide a wiping action, which effectively cleans cuvettes and scum from the lower surfaces. This action occurs automatically without attention from the observer. The light beams from the two plungers are compared in the divider which forms the sensitive dividing line. When these fields are matched, the dividing line virtually becomes invisible, making very accurate readings possible.

### Cups

The separable cups also contribute to ease and convenience in use, because they are removed from the front, where they are easily

and easily reached. They combine the best features of other colorimeter cups. The bottoms are separable for easy cleaning. The cup body is flared sufficiently to prevent overflow when the cup is filled to a depth of 50 mm. All parts are interchangeable for economy. The zero adjustment is uniform for convenience. This uniformity is secured by careful standardization of the thickness of the cups and bottom plates for all cups. For use with substances deleterious to rubber, fused cups are available.

Catalog No.	Description	Price
10131	Spencer Colorimeter with Direct Reading Scales, in design with 2 cups and 115 volt bulb	\$12.50
10132	Same as above, but with 2 fused cups	\$15.00
10133	Cup complete with washer cap, and glass bottom plate	\$1.50
10134	Plunger for No. 10131	.50
10135	Cup with fused bottom plate	.75
10136	Glass Cup Body only for No. 10132	1.00
10137	Plastic Cap for cup	.25
10138	Glass Bottom Plate	.25
10139	Rubber for No. 10133	.10
10140	Light Shield for Cup	.50
10141	Contact Bulb, 75 watt, 115 volt for Colorimeter	1.00
10142	Contact Bulb, 15 watt, 220 volt for Colorimeter	.50



# Spencer Delineascopes

As far back as the early Greeks, visual aids were used by pedagogues to supplement lessons. Class journeys were considered very valuable and actual objects were used for demonstration purposes.

Through the years, these ideas were carried on by such noted educators as Froebel, Herbart and Dewey, who were constantly striving to limit formalism and bookishness.

Today, through the efforts of these individuals and the arts of photography and printing, the facts of the world are presented in the classroom in charts and pictures as well as in words.

The surgeon uses color slides in talks to nurses in training. The grade school teacher lets her pupils prepare their projects for presentation with an opaque project or

The Army finds speedy visual methods of training men and women for service. Industries plant build morale and train workers with illustrated lectures and motion pictures. High school and college instructors clip articles from newspapers and other periodicals so that their courses will be brought up to the minute by the projection of timely material.

If an instructor could afford to have a good motion picture made to use in his course, results would be ideal. Unable to do this he must use available pictures when he can obtain them. He can, however, afford to make or purchase his own set of slides or assemble materials for opaque projection. Here are some of the benefits:

1. There is ample time to discuss material projected.
2. The projector can be operated easily by adults or children.
3. Group attention is centered on the " "
4. The right pictures or material can be presented at the logical time since the lecturer can select and determine the sequence.

Instructions are given in this catalog for projecting 2' x 2' and 3 1/4" x 4" slides, sidefilms and opaque materials. Combination projectors are very popular. All Spencer Classroom projectors are known as Delineascopes.

## Opaque Combination

One of the most useful and adaptable instruments is the Combination Opaque

Slide Projector. It is an invaluable aid in the rapidly growing field of visual education to project lantern slides, postcards, photographs, drawings, pages in books, mineral or biological specimens and small objects. Since it can be used in the teaching of all subjects at all levels, it meets the demands of city or rural schools, high schools and universities. It is a time and money saver. Today, when so many phases of our life are changing rapidly, this instrument can be used to keep us up-to-date on world developments.

Old methods of instruction are now becoming obsolete and must be replaced in order to keep up with current trends and developments. With an Opaque Projector, it is a simple matter to obtain slides or pictures from a unit and substitute new illustrations.

The following are some of the advantages in using the Opaque Projector:

1. Materials made or assembled by the instructor or students can be used.
2. A tremendous amount of material can be used that is not available on films or slides.
3. Current illustrations from books, periodicals and newspapers can be inserted between films or slides to complete a lecture.
4. The Opaque Projector and the materials used with it are inexpensive.
5. The darkened room centers attention on the projected image.

A Spencer Opaque Delineascope is, in effect, a magnifying glass which dramatically enlarges teaching material on your projection screen. Its value is widely recognized.

Combination instruments will project opaque materials, lantern slides, current popular 2' x 2' slides, sidefilms and micro slides, providing flexibility in the use of visual materials. For example, current interest can often be added to a regular lantern slide lecture by inserting a few clippings from recent periodicals. A swing of the handle changes the path of light from slides to opaque illustration.







## Opaque Delineascopes — Model V, VA, VAC

Photographs, pages in books or periodicals, maps, charts or small objects—any of these inexpensive materials within the 6" x 6" area of the opaque aperture can be projected on the screen.

Spencer Opaque Projectors provide clear vividly projected pictures that effectively transform indifference into eager interest. Their use is increasing rapidly in the grade schools where improved teaching efficiency is saving community funds. Hundreds of instruments have been used by the Services to train American men and women in the arts of war.

Model V projects opaque material only. Model VA, opaque material, lantern slides and 2" x 2" slides. Model VAC, opaque, lantern and 2" x 2" slides, slidefilms and micro slides.

By the addition of accessories Model V may be converted into a VA or VAC.

### Standard Features

1. The lamphouse is supported at the front end on yokes, to permit placing large books or periodicals under the opaque aperture.
  2. The first surface mirror is slant-adjusted rather than set versus for much greater adaptability and for maintaining screen brightness.
  3. A stream of cool air is forced directly across the face of the copy by a reversible motor-driven fan. Manual control of the fan speed is accomplished with a variable rheostat.
  4. Images from opaque objects or lantern slides come up on the screen at a 20 foot projection distance.
  5. The opaque aperture is 6" by 6". However, larger illustrations may be inserted and 6" square areas projected.
- Dimensions: Model V: Height, 16" Width, 8 1/4", Length 17" Weight approx 40 lbs.*

### Valuable Accessories

The patented foot control is new, exclusive and, in the opinion of many, the greatest improvement in instruments for opaque projection since the addition of the cooling fan. A slight pressure of the foot lowers the platform raising both hands free to insert,

properly position or remove the illustrations.

2. A masking plate and paper guide is available for presenting single lines of printed copy and to facilitate the handling of teaching material mounted on paper strips or rolls.
3. Elevating legs provide a convenient means for centering the image on the screen.
4. Slide carrier for 2" x 2" slides.

### Magnification Table

Figured on basis of 6 inch square upon fig.

Focus of Lens in Inches	Distance from Screen in Feet						
	8	10	15	20	25	30	
16	Side of Screen Projected	2.5	3.2	3.1	7.0	8.9	10.8
				1.5	2.0	2.5	3.0

Model V Delineascope for opaque material, with one 100 watt, 115 volt, medium projection base bulb 4" diameter, 16" or 18" focus objective as selected, platform for loose sheets, two post card holders with cooling fan and adjustable rheostat, 15 foot adjustable rubber covered cord with switch.

Model VA Delineascope for opaque materials and standard 3 1/4" x 4" glass slides equipped same as No. 1776.

Model VAC Delineascope for opaque materials, glass slides, slidefilms, and micro slides, same as No. 1776 with the addition of No. 1774.

Combined Slidefilm and Micro Slide Attachment.

Elevating device for above models.

Lantern Slide Projector to convert Model V into VA. Current holders.

Leatherette Covered Carriers for 3 1/4" x 4" slides.

Slide Carrier for 3 1/4" x 4" and 3 1/4" x 3 1/4" English slides.

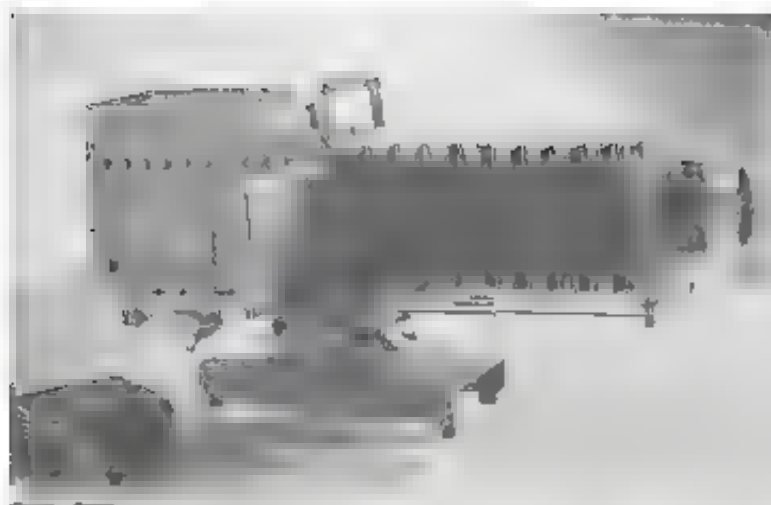
Slide Carrier for 2" x 2" slides.

Four Control for operating platform.

Masking Plate and Paper Guide to fit on platform.

500 watt, 115 volt Bulb. Med. P. F. Base.

500 watt, 120 volt Bulb. Med. P. F. Base.



Left: Model D Delneoscope. Right: Open lamphouse and the slide attachment. Telling features shown.

## Classroom Delneoscope—Model D

Model D Delneoscope is a large, sturdy, trouble-free, spiral focusing device. It is built to withstand years of hard use. It is built to meet the unfavourable conditions of a classroom. It is built to meet the needs of a teacher. It is built to meet the needs of a student. It is built to meet the needs of a school. It is built to meet the needs of a nation.

Model D Delneoscope is a large, sturdy, trouble-free, spiral focusing device. It is built to withstand years of hard use. It is built to meet the unfavourable conditions of a classroom. It is built to meet the needs of a teacher. It is built to meet the needs of a student. It is built to meet the needs of a school. It is built to meet the needs of a nation.

### Additional Features

1. Sturdy, trouble-free, spiral focusing adjustment.
2. Hinged lamphouse permits quick bulb change.
3. Carrying handle and lamphouse handle of non-heat-conducting material.
4. Non-sagging bellows—supported by double extension rods.
5. Projection range of 6 1/2" to 16" focus may be used without change of con-

### Features

1. Hinged lamphouse permits quick bulb change and protects the metal parts. Bright parts are chromium plated.
2. Due to the whiteness of the projected light, slides containing colors are imaged authentically.
3. Fairly satisfactory projection of 2" x 2" slides can be accomplished by the addition of a special slide carrier.
4. Dimensions: Height, 10 1/2", Width, 5", Length, with bellows closed 15 1/2", Base 4 1/2" x 9", Weight, 16 lbs.

An accessory that is useful with this equipment is the combined Sidefilm and Micro Slide attachment which fits in place of the bellows.

Heat absorbing glass for additional protection to color slides is available.

Cat. No.	Description	Price
24	Model D Delneoscope for 3 1/2" x 4" slides with inc. 300 watt, 115 volt medium prefocus base bulb, diameter .2" focus lens (specify as desired), 15 foot detachable rubber covered cord with switch, complete in metal carrying case.	
24-1	Same as above but with lens of 1 1/2" diameter.	
24-2	Slide Carrier for 3 1/2" x 4" slides for 3 1/2" x 4" and 2 1/2" x 2 1/2" English slides.	
24-3	Slide Carrier for 2" x 2" slides.	
24-4	Combined sidefilm and micro slide attachment.	
24-5	Micro DC includes 3475 and 3575 100 watt, 115 volt bulb, Med. P. F. Base.	MLP
24-6	500 watt, 120 volt bulb, Med. P. F. Base.	MLP
24-7	Heat Absorbing Glass.	



## Science Declineascope—Model B

By means of this unusual Declineascope, an entire experiment can be conducted and the results projected onto a screen for all the class to see. The Declineascope can project a picture of 3 1/4" x 4" slides, contours of topography, and many other things shown vividly. The instructor can even make pencil sketches on a ground plane and project them.

Here are but a few of the experiments which can be dramatically effective:

1. Magnetic induction

Properties of magnetic fields

Surface tension

Mixtures

Crystallization

Refraction

Precipitation and thermometer experiments in chemistry

Thermometer and other meter readings

Contours of insects, small animals, plants, etc.

The instrument occupies very little space on the lecture table (5' x 13').

It may be set permanently set up, ready for immediate use. A solid back, beaded, projection screen should be hung on the wall back of the lecturer at a height and angle bringing the picture into view of the entire class.

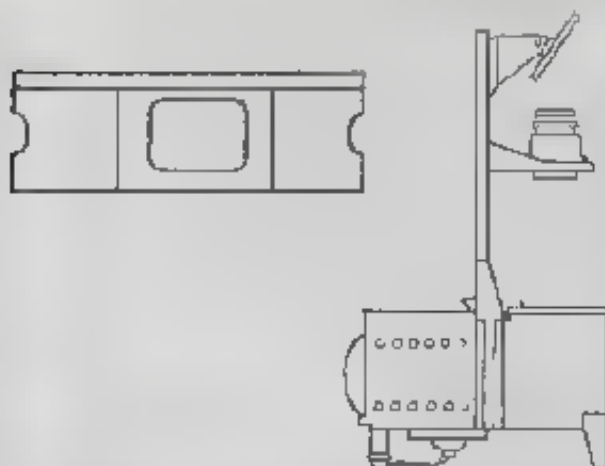
When the Declineascope is set up 5 1/2' from the wall and the screen is hung 6' from the floor, a 6 1/2 inch focus projection objective provides a 30' x 36" picture.

### Additional Features

1. An adjustable mirror permits centering the picture on the screen.
2. Hinged lamp house permits quick on/off change.
3. Lamp house handle of non-heat conducting material.
4. Durable black cracked finish beautifies and protects the metal parts. Bright parts are chromium plated.
5. Due to the whiteness of the projected light, no slides or specimens are damaged.
6. Projection table with a guide for slides 4' x 13 1/2" with a clear glass plate 4' x 13 1/4" over the 2 7/8" x 3" x 1/4" slide.
7. Sturdy, trouble-free, spiral focusing adjustment.
8. Dimensions: Height, 23", Width, 5", Length, 13", Weight, 14 lbs.

No.	Description	Price
1	Model B Science Declineascope with 500 watt, projection objective, projector, meter 6 1/2" or 8 1/2" focus lens as selected, 15 foot detachable rubber covered cord with switch, complete in metal carrying case.	\$14.95
2	Solid back, beaded screen 4' x 13 1/2" . . . . .	4.00
3	30' x 36" projection screen . . . . .	1.00
4	30' x 36" projection screen . . . . .	1.00
5	30' x 36" projection screen . . . . .	1.00

Left: Large table with flash glass plate and guide for slides. Drawing of Model B shows the Declineascope and spiral focusing mount for mounting the Declineascope Model B in use.







## Auditorium Colorslide Delineascope—Model GK

New brightness, vividness, and realism have been brought to the projection screen by Model GK Auditorium Colorslide Delineascope. It is a 750 watt instrument and projects 2" x 2" or 3½" x 4" slides.

Clear sharp definition and a flat field is secured with objectives 2½" in diameter. For 2" x 2" slides, the 6½" (f/2.75), 8½" (f/3.60), 10" (f/4.3), or 12" (f/4.8) focal lengths are available. For the larger slides these objectives may be used, and in addition lenses of 12", 16", 20" and 24" are listed. Critical focusing is accomplished smoothly by rack and pinion.

Different condensing systems are used to direct the light efficiently through the small and large slides. Each condensing system is mounted in a container which may be lifted out as a unit and replaced by the other.

Especially important is the protection against film damage afforded by an ingenious cooling system.

For large auditoriums and since the full brilliance of Model GK is appreciated. For smaller intimate gatherings, combination for slides of different density can be controlled with an iris diaphragm.

Two carrying handles make it possible to remove the instrument from the projection table immediately after prolonged use.

The electrical system includes 15 feet of rubber covered non-kinking cord, a toggle switch, a rheostat to control the speed of the cooling fan when used on other than 60 cycle A.C., a 750 watt, 115 volt medium prefocus type projection lamp.

### Additional Features

Elevating legs are located on the front handle support on the rear allows for mounting the instrument when operating from a balcony post.

Hinged lamp house permits quick bulb or condenser change.

Non-sagging bellows is supported by

Cooling fan has a rheostat to control the speed when operating on other than 60 cycle A.C.

**Dimensions:** Height, 8½", Width 7½", Length, bellows closed, 11" Weight, 21 lbs.

### Magnification Table

Focal length of lens in inches	Upper figures show the width in feet of image on the screen for 2" x 2" slides with an aperture of f/2.75. Lower figures show the width in feet of image on the screen for 3½" x 4" slides with an aperture of f/4.3.									
	6	8	10	12	14	16	18	20	24	30
6	1.6	2.3	3.0	3.6	4.3	5.0	5.7	6.4	7.7	9.9
8	2.1	3.1	4.0	4.8	5.7	6.6	7.5	8.4	10.2	13.2
10	2.7	3.9	5.0	6.0	7.1	8.2	9.3	10.4	12.6	16.5
12	3.2	4.6	6.0	7.2	8.5	9.8	11.1	12.4	15.1	19.9
14	3.7	5.2	6.7	8.1	9.6	11.1	12.6	14.1	17.3	22.9
16	4.2	5.8	7.5	9.1	10.7	12.4	14.1	15.8	19.5	25.9
18	4.7	6.4	8.3	10.0	11.8	13.6	15.4	17.2	21.4	28.9
20	5.2	7.0	9.0	10.8	12.7	14.6	16.5	18.4	23.0	31.9
24	6.3	8.4	10.8	12.9	15.2	17.5	19.8	22.1	27.6	38.9

Auditorium Colorslide Model GK. Lens, iris diaphragm.

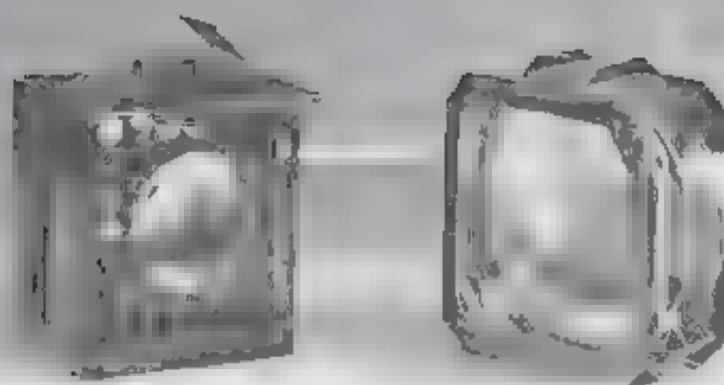


Fig. 1. Delinascopes. A, for 2" x 2" slides; B, for 3 1/4" x 4" slides.

COMPLETE DELINASCOPES, ready for operation, with metal carrying case.

Model No.	Description	Price
3597	Model CR Delinascopes for 2" x 2" slides. Equipped with 6 1/2" diameter 10" focus lens, 2" x 2" condensing lens system, and 2" x 2" projection lens.	\$12.50
3598	Same as above, but with 12" focus lens.	\$15.00
3599	Model CR Delinascopes for 3 1/4" x 4" slides. Equipped with 8 1/2" diameter 10" focus lens, 3 1/4" x 4" condensing lens system, and 3 1/4" x 4" projection lens.	\$15.00

NOTE: (Two objectives are necessary if both sizes of slides are used and same sized screen images are desired. See magnification table.)

Diameter of all objectives listed is 2 1/2".

#### ACCESSORIES, for above instruments.

3602	Deluxe Leatherette Covered Carrying Case with storage space for slide boxes, extra objectives, extension cords etc., can be furnished with any of the above Delinascopes. Attached to the microscope.	
3602	Same as above when purchased separately.	
3592	Condensing Lens System for 2" x 2" slides. Complete in unit mounting.	\$7.50
3603	Condensing Lens System for 3 1/4" x 4" slides. Complete in unit mounting for use with objectives.	\$7.50
3605	Slide Carrier for 3 1/4" x 4" slides.	
4706	Slide Carrier for 3 1/4" x 4" and 3 1/2" x 3 1/4" English slides.	
4030	750 Watt, 115 Volt Bulb, Med. P. P. Base.	M.C.P.
4031	750 Watt, 110 Volt Bulb, Med. P. P. Base.	M.C.P.
3603	iris diaphragm to reduce light intensity for small screens or for thin slides.	

#### For Use with 2" x 2" Slides

3561	Projection Lens 2 1/2" diameter 6 1/2" focus	
3562	Projection Lens 2 1/2" diameter 10" focus	
3564	Projection Lens 2 1/2" diameter 12" focus	
3566	Projection Lens 2 1/2" diameter 18" focus	

#### For Use with 3 1/4" x 4" Slides

3564	Projection Lens 2 1/2" diameter 10" focus	
3566	Projection Lens 2 1/2" diameter 12" focus	
3570	Projection Lens 2 1/2" diameter 18" focus	
3574	Projection Lens 2 1/2" diameter 20" focus	
3578	Projection Lens 2 1/2" diameter 24" focus	



## Colorslide DeLineascope Model MK

In big range of screen results, Spencer Model MK DeLineascope will exceed your expectations. The ratings of these projectors, 100, 150, 200 and 300 watts, do not indicate the true magnitude of illumination which reaches the screen. Only an actual demonstration can reveal how brilliantly the full beauty and quality of your slides are magnified and projected.

### Film Protection

The powerful illumination is also safe for your color slides. Our engineers have designed these models to provide efficient ventilation, have included heat-absorbing glass where necessary and have designed a cooling attachment to be used with the 100 watt instrument.

### Four Models

The 100 watt model has a large diameter two element condensing system (made of glass with heat absorbing qualities) producing a brilliant, evenly illuminated air.

The 150 watt model is the same as the 100 watt model except for the bulb and the addition of a separate heat absorbing glass. The 200 watt model may be converted readily into a 150 watt by adding the heat absorbing glass and substituting a 150 watt bulb.

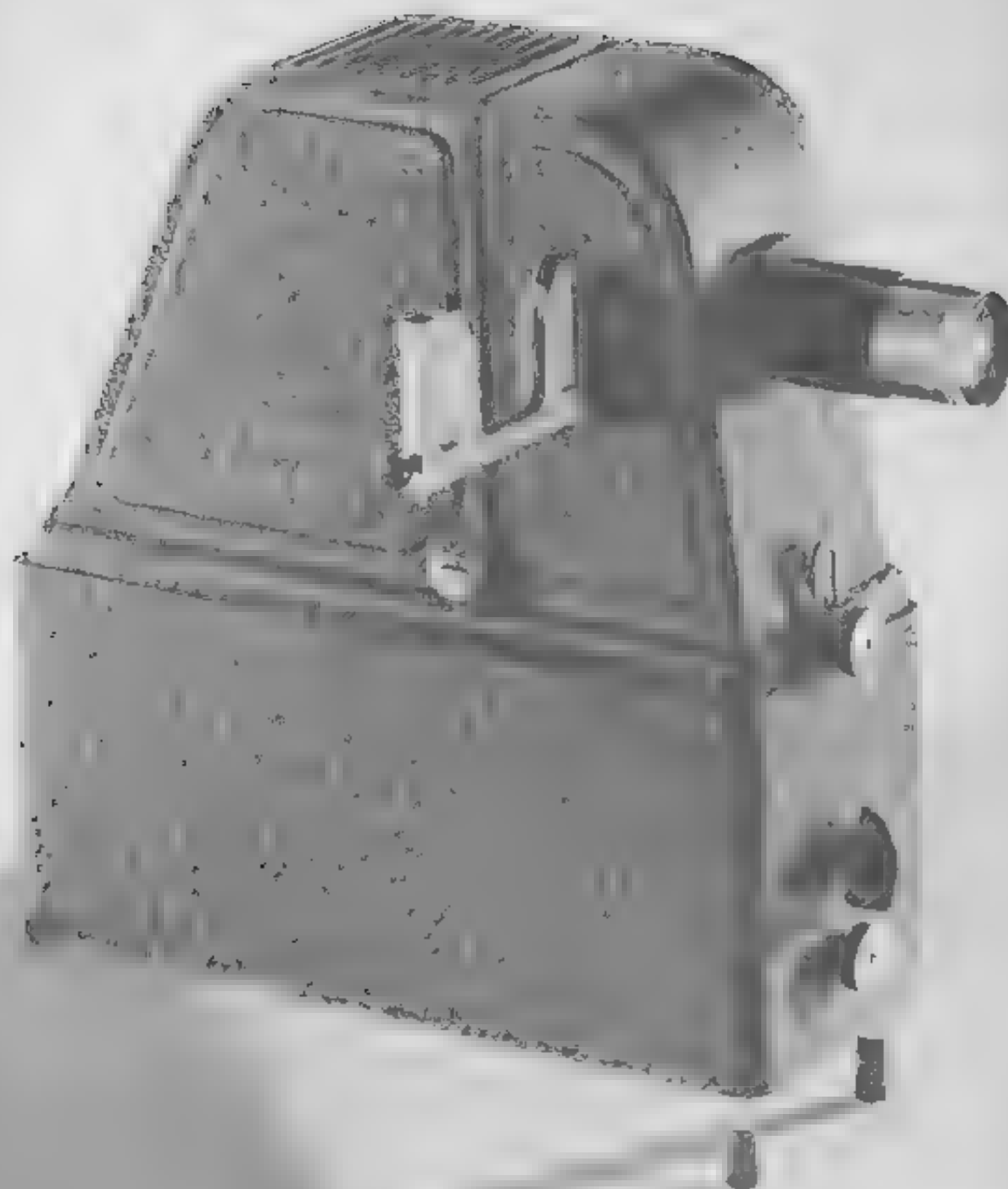
The 300 watt model has a three element condensing system and highly efficient heat-absorbing glass. It can be converted into a 300 watt instrument by substituting a 300 watt bulb and adding the fan cooling attachment.

Except for the bulb and fan cooling attachment, the 200 and 300 watt models are identical.

*Model MK (100, 150, or 200) DeLineascope for 2" x 2" slides. Cooling fan unit in background can be used with Model MK 300.*









## Selecting Your Projector

For projection in a small or medium sized room, the 150 watt model will be very satisfactory. For large classrooms, shops, auditoriums, or where it is difficult to darken the room, a 200 or 300 watt model is preferable.

**NOTE:** MK 100 can be converted only to MK 150.  
Only MK 200 can be converted to MK 100.

## Sturdy Construction

These instruments are designed for a lifetime of service, with a cast base, heavy gage steel lamp house, reinforced with cross members and embossed for added strength. The finish is a durable wrinkle enamel.

## Additional Features

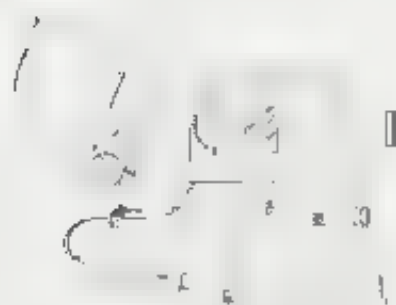
- 1 Sharp definition is secured with the well corrected Spencer projection lens of 5" focal length and a speed of 2.

- 2 Has a self-levelling elevating device to locate the picture on the screen.
- 3 Hinged lamp house permits quiet switching.
- 4 Efficient cooling provides safety for color slides.

The chart below gives the widths of screen images (in feet) obtained with Model MK Delineoscopes when used at various distances from the screen. The 5" focus objective is the only one available for these instruments.

## Magnification Table

Distance from screen	Width of image on screen
Object	2.7 feet
"	"
"	"
"	"



Width of MK 100 at 50' distance



Width of MK 200 at 50' distance

Model No.	Description
3783	Model MK 100 Delineoscope for 2" x 2" slides, 100 watt Bulb, 5" Focus Objective, Slide Carrier
3780	Model MK 150 Delineoscope for 2" x 2" slides, 150 watt Bulb, Heat Absorbing Glass, 5" Focus Objective, Slide Carrier
3784	Model MK 200 Delineoscope for 2" x 2" slides, 200 watt Bulb, 5" Focus Objective, Slide Carrier
3785	Model MK 300 Delineoscope for 2" x 2" slides, 300 watt Bulb, 5" Focus Objective, Slide Carrier and Cooling Fan Unit

Model No.	Description
3787	200 watt Bulb, Med. P. F. Base for Model MK 100
3789	300 watt, 1.5 v.p. Bulb, Med. P. F. Base for Model MK 100
3789	300 watt, 120 V. Bulb, Med. P. F. Base for Model MK 100
3788	Heat-Absorbing Glass for Model MK 150
3785-606	Heat-Absorbing Glass for Models MK 200 and MK 300
3708	Slide Carrier for all MK Models
3719	Cooling Fan Unit
3713	Leatherette Covered Carrying Case for Models MK 100, 150 or 200 with storage space and extra bulb
3714	Leatherette Covered Carrying Case as above for Model MK 300 and MK 200 when supplied with Cooling Fan Unit

Model MK 100 Delineoscope for 2" x 2" slides.

## Protection (Objectives and Consequences) Linked to the Management of

[illegible]



## Delineascope Accessories

### Projection Bu ts

The prices of projection bulbs are changed frequently. Therefore, we are not pricing bulbs.

All orders for bulbs are accepted at manufacturer's current prices, MCP.

When ordering bulbs, give us the following information:

- (1) Model of Delinescope B, D, V,  
etc
- (2) Wattage of Bulb
- (3) Voltage of Bulb
- (4) Type of Base

Projection bulbs for 220 volt circuits are available for Models B, D, V, VA, MK 150.

## Screens and Tables

We do not supply screens for projection tables. These are available through most of our distributors.

## Mirrors and Reflectors

NO	Description	Price
	100 or for MK, 30 or 50 Rider or for MK, 200 or 300 or Models B, C, or 4K or chamber mic on for M or J	
3385-005	First surface mirror for Model B	
3374-003	First surface mirror for Models V, VA, and VAC	
3372-006	Ceramic reflector for Models V, VA, and VAC	
	Back mirror for Models V, VA,	
3372-007	Side mirror, left or right, for Models V, VA, and VAC	

### Slide Carriers

For  $3/4'' \times 4''$  and  $3/4'' \times 3/4''$  Eirp<sub>h</sub>

### Combination Slidefilm and Microslide Attachments

These attachments are for use with Lantern Slide or Combination Opaque and Lantern Slide Diaboscopes. They project 35mm single frame medium. Also, they have slideways for 3" x 1" microscope slides.

To secure the correct attachment it is necessary to specify the Deimoscope Model with which it is to be used. Objective of 1 $\frac{1}{2}$ " diameter, 3" focus is included.

### Magnification Table

3671 E. Furman Ave. N. W.



## Heat-Absorbing Glass and Mounts

Cat. No.	Description	Price	Cat. No.	Description	Price
3787-604	Glass only for 3607 or 3608 condenser Unit and G2		3785-5	Meta mount only for MK 200 or	
3780-601	Glass only, for MK 150		3785-817	Glass in meta mount for MK 200 or 300	
3780-1	Meta mount only, for MK 50		416	Glass 4 1/2" diameter, for Model D	
3718	Glass in meta mount for MK 50				
3785-606	Glass only, for MK 200 or 300 and G2 for 2" x 2"				

## Projection Data

The efficient minimum and maximum projection distances of the different models of Diasecopes are as follows:

Models V, VA, VAC	10 feet to 30 feet
Model D	10 feet to 30 feet
Model B	5 feet to 15 feet
Model GK	10 feet to 100 feet
Model MK	10 feet to 30 feet
Screen Attachment for Models VAC and D	— 10 feet to 30 feet

Brighter pictures are obtained at the shorter projection distance. Illumination

obviously decreases as the projection distance increases.

Consult the magnification tables to select the objective that produces the proper sized image to fill your screen at the projection distance desired.

Condensing cases for use with the various optical combinations are shown.

Reference to the table below makes it possible to determine what focus objective is required to give the size of picture desired at a given distance or the various sizes of pictures which can be obtained with an objective at varying distances.

For Standard Lantern Slides 3 1/4" x 4 1/4"  
Figured on basis of 3-inch clear opening in

Focus of objective Inches	Distance from Screen, in Feet										F	M
	4	5	6	8	10	15	20	25	30			
6 1/2	1.0	2.0	2.5	3.4	4.4	6.7	9.0	11.1	13.3			
						+			+			
				6.7	7.7			10.3	13.9			
				7.4	8.4			10.8	15			
7					8.3			10.8	12.2	14.6		
10			11.3	12.6	15.5	18.6	21.3	24.1	27.1	29.1	34.8	
10	Width of Screen				2.0	1.8	1.6	1.3	1.1	1.0	1.4	
14	Image in feet				1.6	2.2	3.0	3.5	4.7	6.0	7.2	8.5

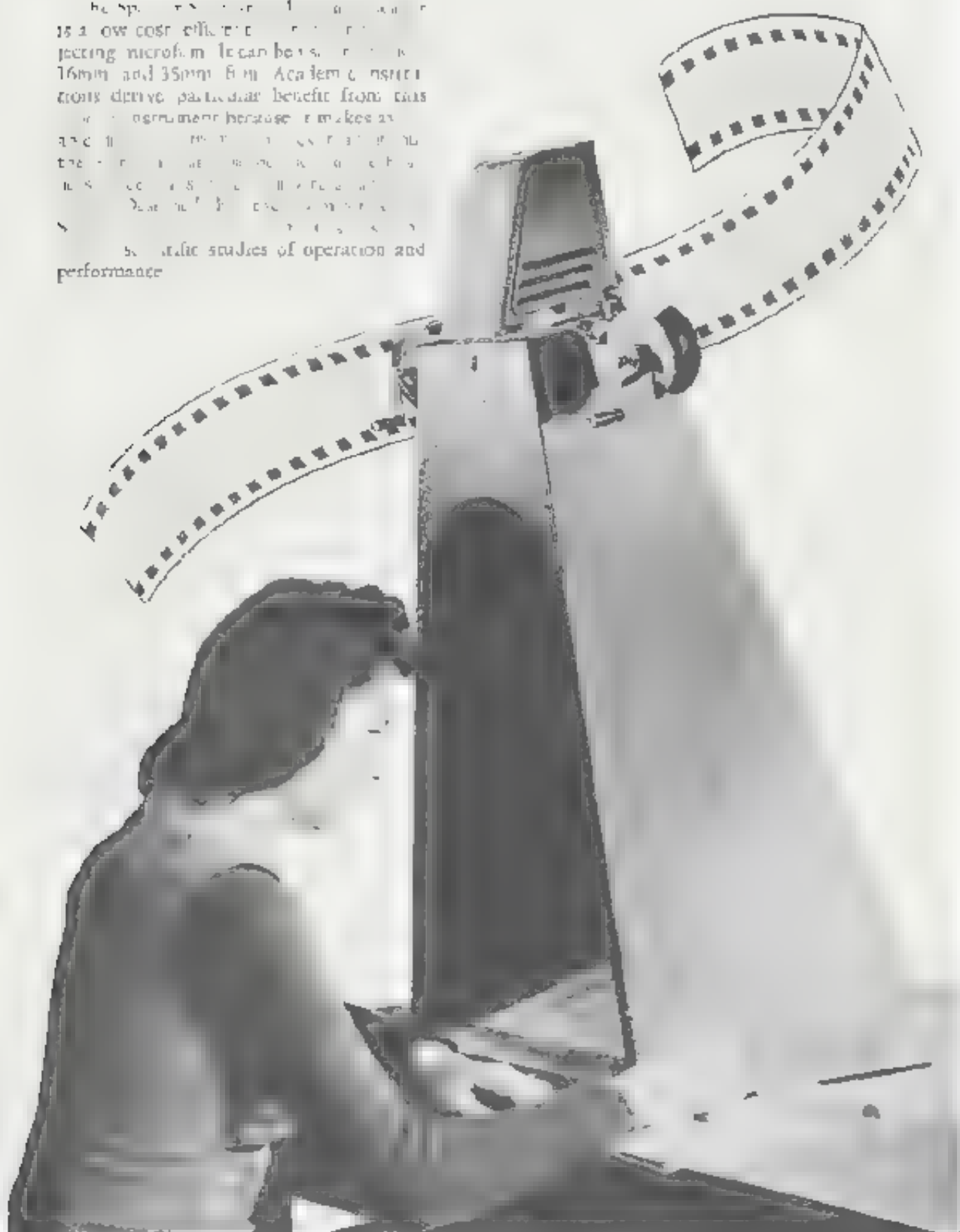
To determine approximately the focus objective required, which using double frame film (24mm. by 36mm.), use lantern slide size above and divide image width by 2.



## Spencer Microfilm Reader

The Spencer Microfilm Reader is a low cost efficient instrument projecting microfilm (can be 8, 16, 35mm and 35mm film) Academy format onto a screen. It is particularly suitable for use in schools and libraries where it makes an excellent instrument for the study of the history of the film industry. It is also a valuable instrument for the study of the history of the film industry.

For static studies of operation and performance





## Purposes of Microfilm

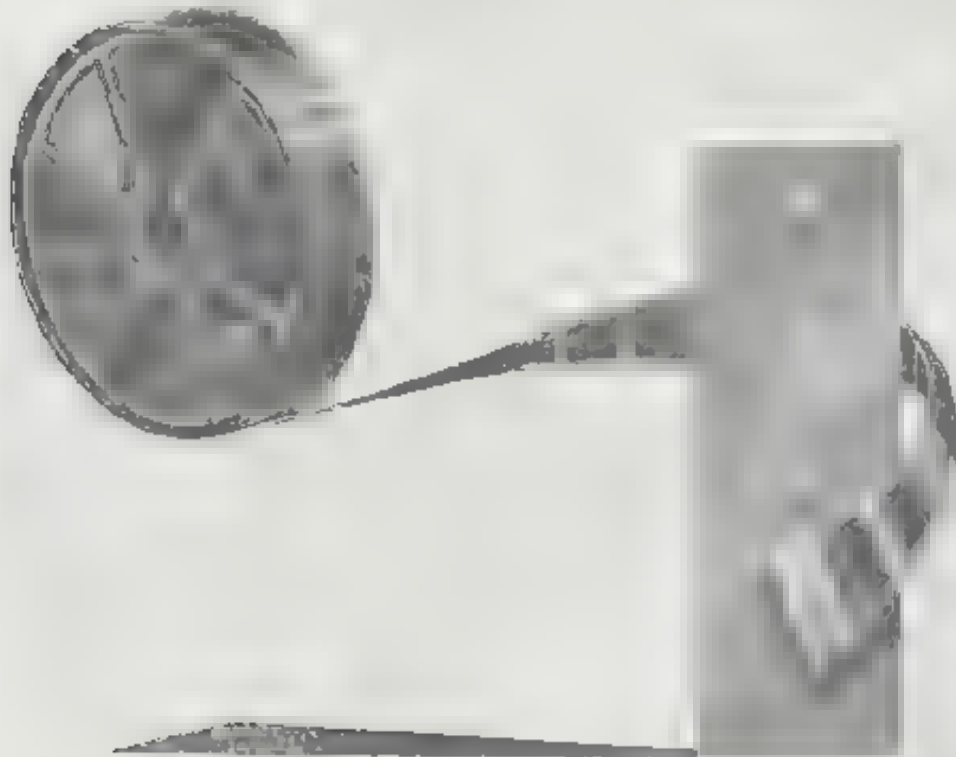
The purpose of microfilm is to make available at relatively low cost and with great convenience in handling and storage, copies of the documentary information of the world which would otherwise be difficult, if not impossible, to obtain.

Scientists, research workers, graduate students and librarians, can read on microfilm the references so important to their work. Most of the repositories of the world have means for producing microfilm copies of documents too precious or rare to lend.

Microfilm has an important place in the administration of business records. Occupying less than 5 percent of the space originally used by the records it replaces, this medium reduces the cost of storing and

maintaining files of important data. Microfilm copies of irreplaceable correspondence, engineering records, forms, contracts and other such material can be stored in safety deposit vaults away from the business premises and safe from the hazards of fire and theft. Once photographed in order, a file cannot be upset. Copies of individual parts of the record can be made readily by standard photographic methods. Where duplicate files are necessary in separate locations, inexpensive copies can be printed and made available to those who must have access to the information they contain.

International correspondence by air can be handled by microfilm at a fraction of the cost for transporting paper letters.





## Scholar's Microfilm Reader

The Spencer Scholar's Microfilm Reader consists of a projection head mounted upon a shadow box which protects the screen from extraneous light. The projection head is a modern well designed optical projection

long life 100 watt 1.5 volt, spotlight bulb, the proper condensing system and a specially designed projection lens. The lamp house is so well ventilated that there is no danger of the heat of the bulb damaging the film. The head unit is held in the shadow box with simple spring clips and may be rotated to project film in either vertical or horizontal azimuth as may be necessary.

The objective is a well corrected system producing a flat undistorted image. An iris diaphragm in the objective permits

comfort of the user. Magnification is 15X.

The screen is of heavy paper, specially treated to render a projected image of agreeable color and contrast and microfilm may be viewed for several hours without ocular fatigue or discomfort. The screen is easily replaceable when

The film is held in the Glass Filmbook or the Roll Film Attachment and moved under the projection aperture to show the desired page or illustration.

The Glass Filmbook consists of two pieces of glass hinged along one edge to permit easy insertion of the film. The film is protected from scratching and held flat in the focal plane of the objective.

The Roll Film Attachment, available at extra cost, accommodates film on 100 foot reels and is simple, sturdy and easy to use. One empty 100 foot 35mm Film Reel is

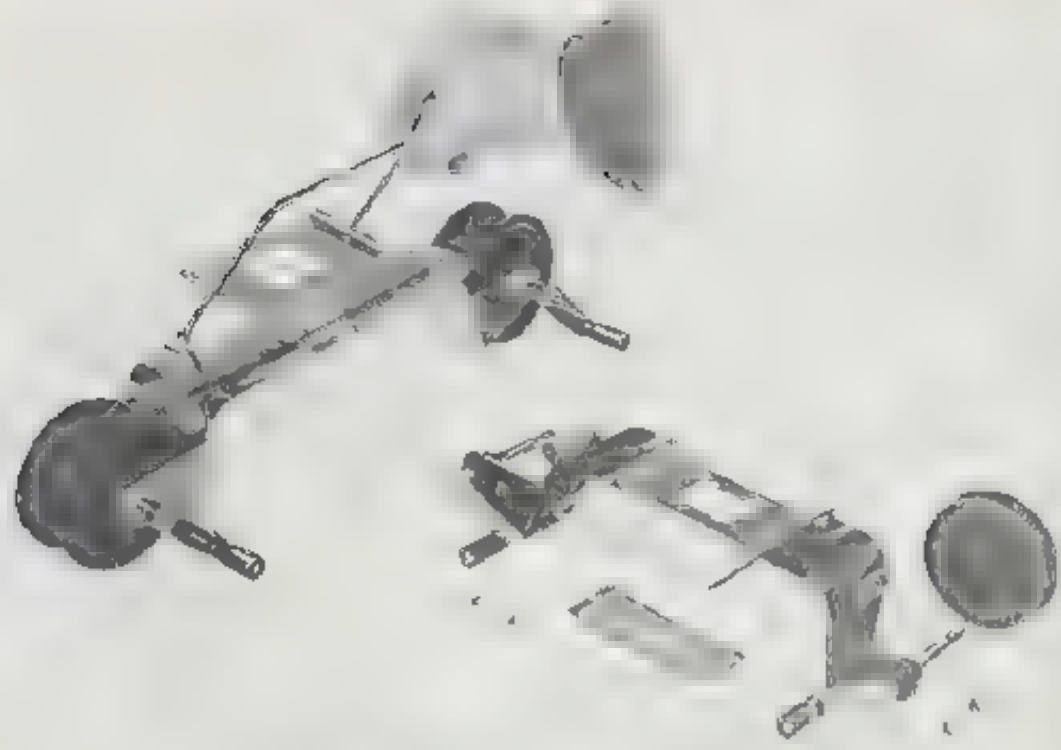
supplied with this attachment. A set of accessories, consisting of the proper spacing washers, a mask to fit the aperture plate of the Roll Film Attachment and an empty 100 foot 16mm Film Reel is available also for reading 16mm microfilm.



Fig. No. 3410 showing glass film book in place







— 1st Rail Film Attachment No. 402 starting yoke  
— and 100 ft. roll of film 1/4" x 16mm for 16mm  
microfilm in rail film attachment



Film Reader 1/4" x 16mm  
Capable of film 16mm

No.	Description	Price
3400	Spencer Microfilm Reader with one Glass Film Mount	
4	No. 400	
3401	Rail Film Attachment with one 100 foot Film Reel	
3402	100 Foot Film Reel, 1/4" x 16mm	
3403	100 watt, 115 volt, GE 60/2 Spotlights Bulb	MLP
3406	100 watt, 230 volt, GE 60/2 Spotlights Bulb	MLP
3407	100 Foot Film Reel, 1/4" x 16mm	

American Optical

# OPHTHALMIC INSTRUMENTS

For many years, American Optical Company has pioneered in research, development, manufacture, and refinement of ophthalmic instruments. Today this enables AO to furnish the professionals with the finest and most complete line of instruments obtainable for all phases of refraction and orthoptic training.

REFRACTING UNIT

OPHTHALMOMETER

STEREO ORTHOPTOR

LEDDY CAMP METER

ADDITIVE PHOROPTOR

LENSOMETER

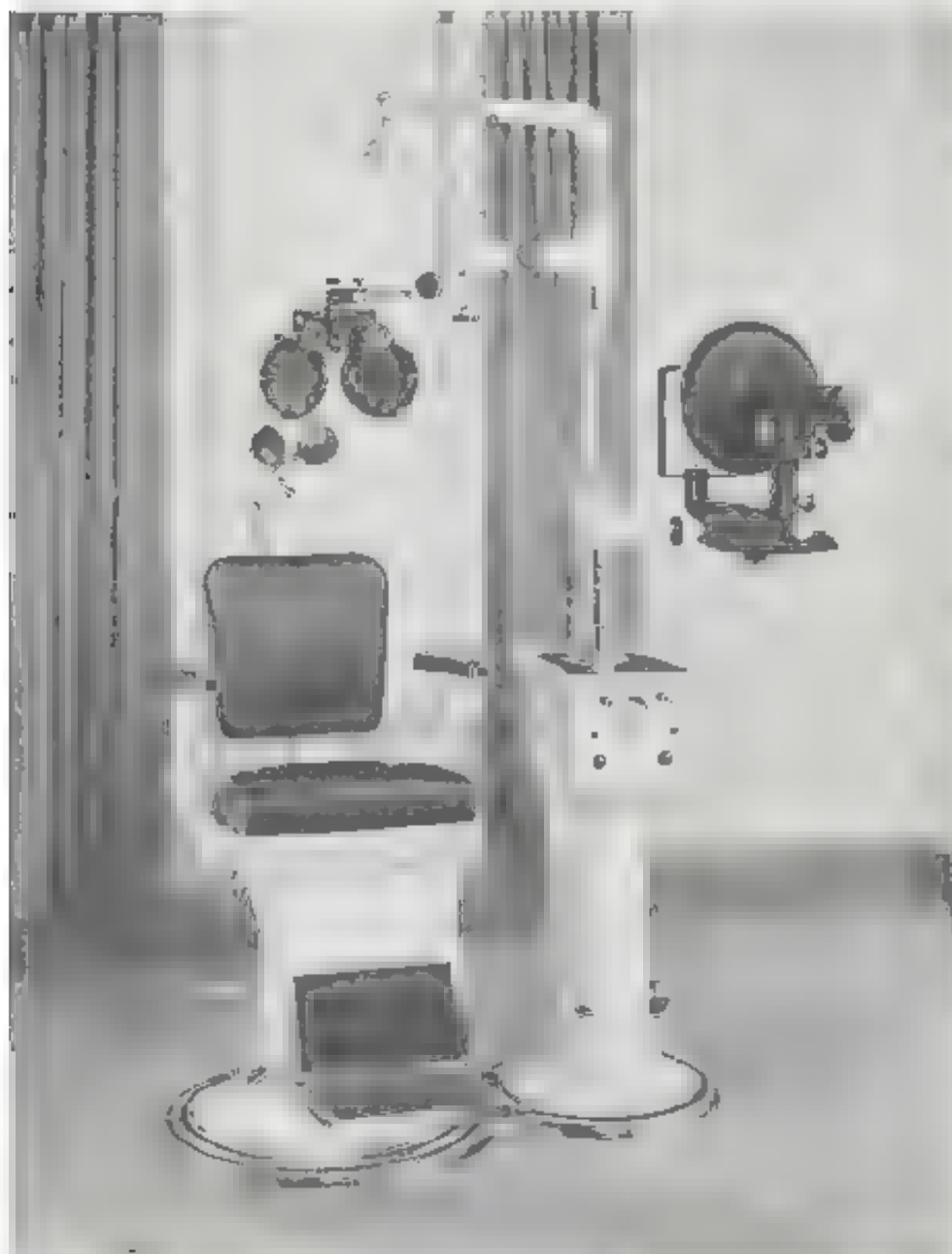
OPERATING LAMP

DIAGNOSTIC SET

PROJECTOR CHAIR

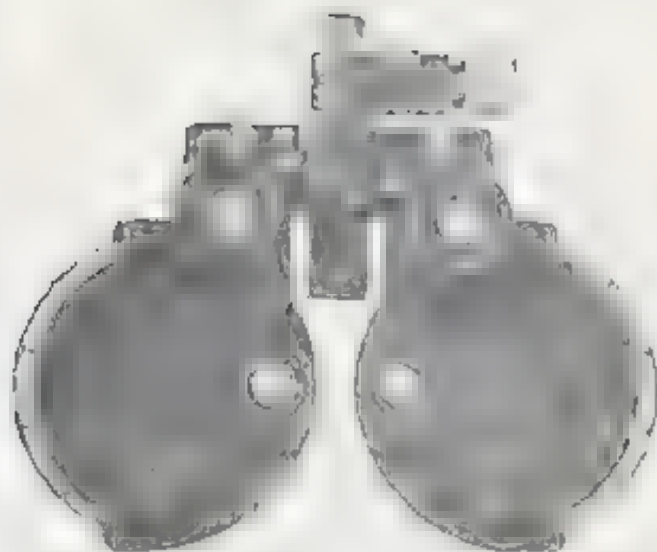
GALTS SCOPE

TRIAL FRAME



*In Line Refracting Unit*—completely integrated means for adjusting

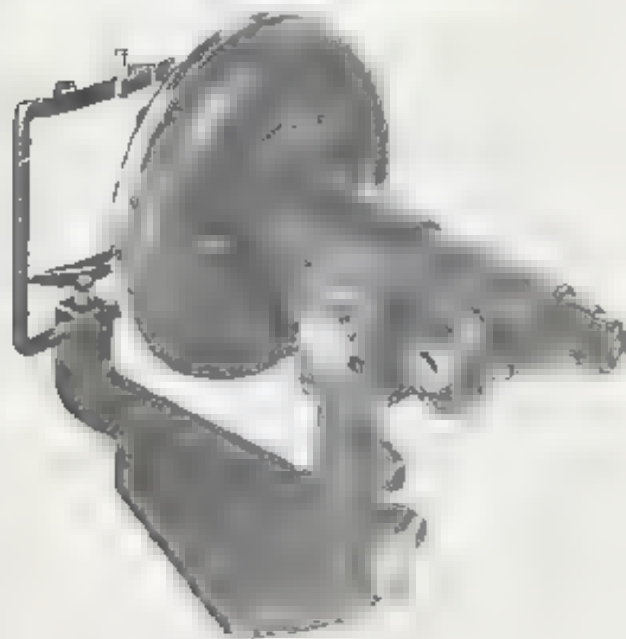
# OPHTHALMIC



*Audiotape Photophor*

establishes necessary relationship between light and color in a single comprehensive system

Every AO ophthalmic instrument is designed and manufactured to meet exacting standards for precision and quality. Their dependability is based on scientific principles, sound engineering, improved design and craftsmanship. In AO's research laboratories, scientists in many fields contribute constantly to the attainment of greater perfection in the instruments and methods provided for use by ophthalmologists in the preservation and correction of vision.



*Ophthalmometer*

measures objectively refractive corneal surface and astigmatism



*AO Polaroid  
Giantscope*

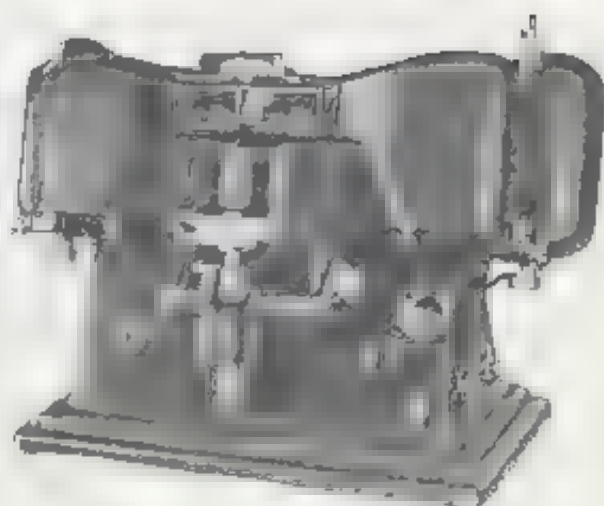
# INSTRUMENTS



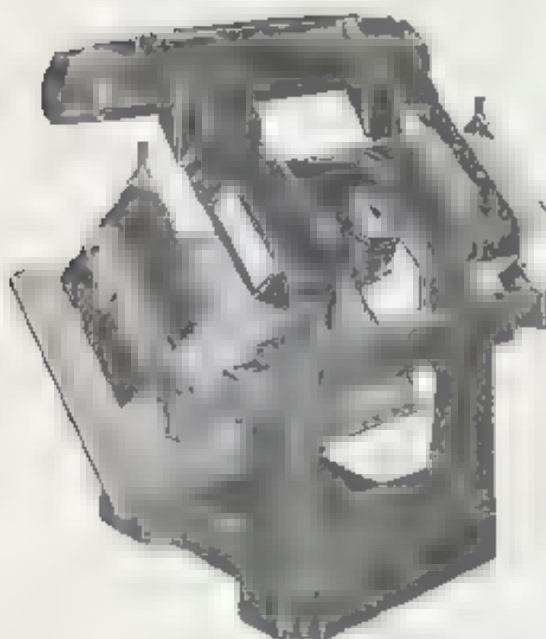
Model 1000



11

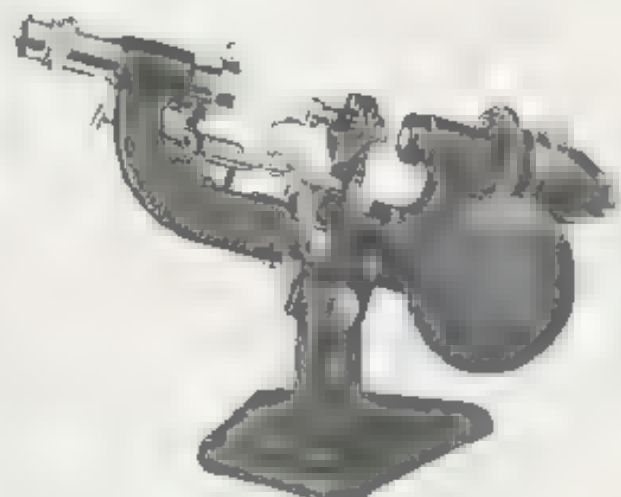


Model 1001



Model 1002

measures central, near, and para-central visual fields.



Model 1003

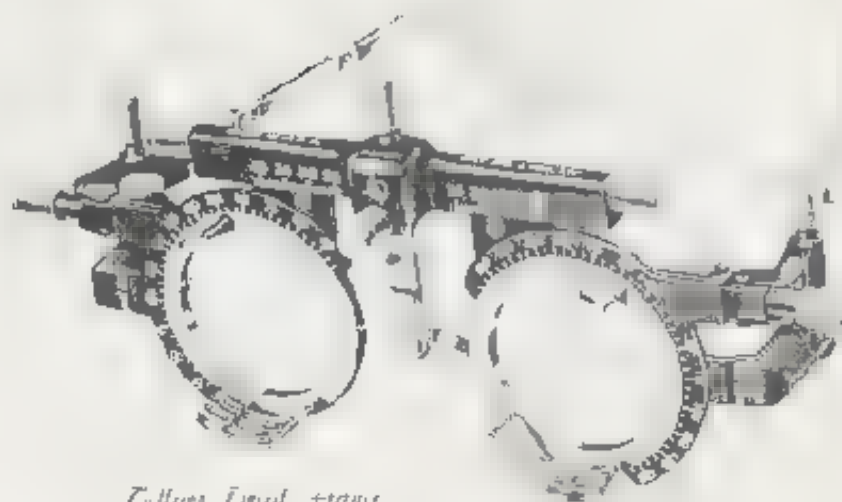
determines the focal strength and axis of any ophthalmic lens.

## Ophthalmic Instruments

in the scope and volume of the instruments offered. AO leadership is widely recognized. The AO monogram on an ophthalmic instrument assures full value in every operation.



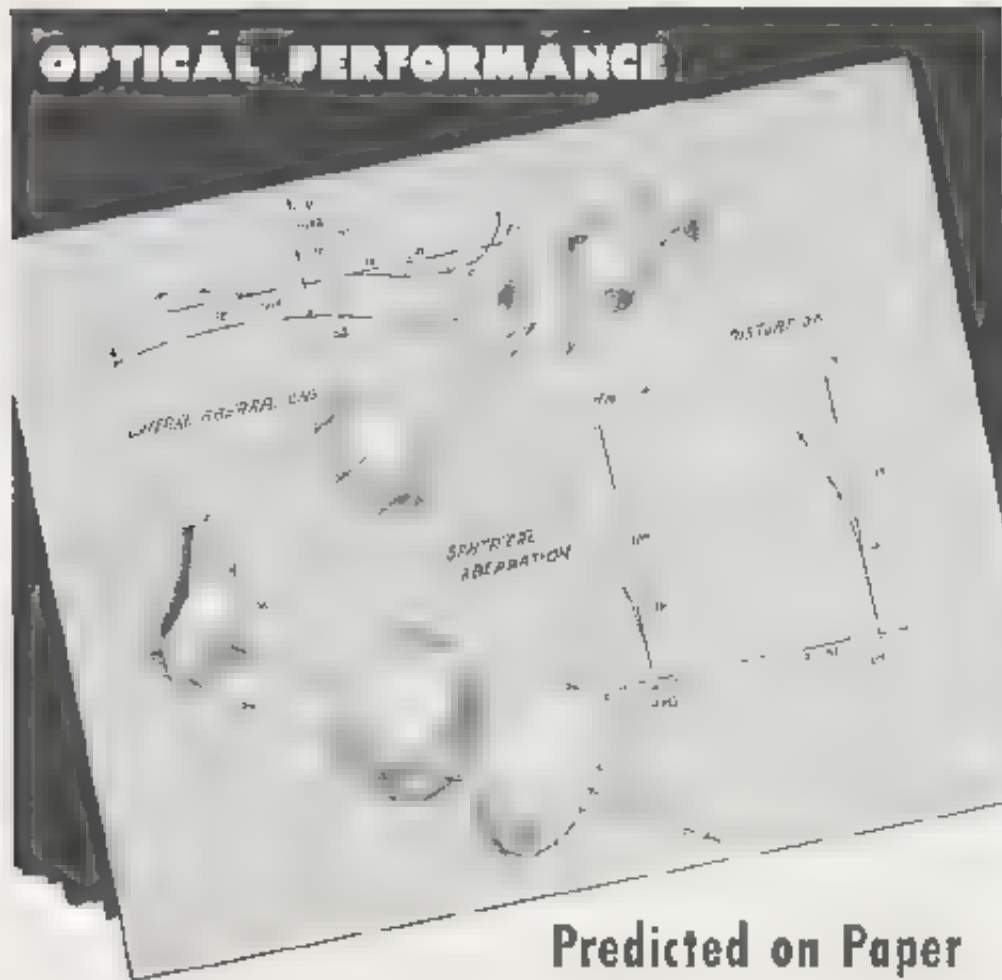
*AO Illuminator*  
 provides uniform illumination  
 required ophthalmic tests



*Collapsing Contact Frame*  
 adjustable spectacle frame to hold test lenses during refraction



*Operating Lamp*  
 provides powerful and effective illumination for examination



**Predicted on Paper**

## Specialized Optical Products

Since our products are designed for specialized applications, we can often recommend an adaptation of our products to meet the needs of a particular application where precise design is required. For this reason, we have developed a series of products which are designed to meet the needs of a particular application.

Quite often we can recommend an adap-

tion of our products to meet the needs of a particular application. We can often recommend an adaptation of our products to meet the needs of a particular application. We can often recommend an adaptation of our products to meet the needs of a particular application. We can often recommend an adaptation of our products to meet the needs of a particular application.







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